

**CONTENTS**  
**(ELECTRICAL ITEMS)**

<u>1</u>	<u>MV POWER CABLE.....</u>	<u>1-1</u>
<u>2</u>	<u>LV POWER CABLE.....</u>	<u>2-1</u>
<u>3</u>	<u>CONTROL AND INSTRUMENTATION CABLE .....</u>	<u>3-1</u>
<u>4</u>	<u>5 KV INSULATION RESISTANCE TESTER.....</u>	<u>4-1</u>
<u>5</u>	<u>10 KV INSULATION RESISTANCE TESTER.....</u>	<u>5-1</u>
<u>6</u>	<u>DIGITAL MULTIMETER.....</u>	<u>6-1</u>
<u>7</u>	<u>DEW POINT METER.....</u>	<u>7-1</u>
<u>8</u>	<u>WINDING RESISTANCE METER.....</u>	<u>8-1</u>
<u>9</u>	<u>BATTERY ANALYSER.....</u>	<u>9-1</u>
<u>10</u>	<u>BDV TEST KIT.....</u>	<u>10-1</u>
<u>11</u>	<u>DGA TEST KIT .....</u>	<u>11-1</u>
<u>12</u>	<u>ONLINE VIBRATION MONITORING SYSTEM.....</u>	<u>12-1</u>
<u>13</u>	<u>ONLINE AIRGAP MONITORING SYSTEM.....</u>	<u>13-1</u>
<u>14</u>	<u>ONLINE PARTIAL DISCHARGE MEASUREMENT SYSTEM.....</u>	<u>14-1</u>
<u>15</u>	<u>ONLINE SILT MONITORING SYSTEM.....</u>	<u>15-1</u>
<u>16</u>	<u>CIRCUIT BREAKER.....</u>	<u>16-1</u>
<u>17</u>	<u>OUTDOOR CURRENT TRANSFORMER.....</u>	<u>17-4</u>
<u>18</u>	<u>OUTDOOR POTENTIAL TRANSFORMER.....</u>	<u>18-1</u>
<u>19</u>	<u>OUTDOOR CAPACITIVE VOLTAGE TRANSFORMER.....</u>	<u>19-1</u>
<u>20</u>	<u>OUTDOOR ISOLATOR.....</u>	<u>20-1</u>
<u>21</u>	<u>OUTDOOR LIGHTNING ARRESTOR.....</u>	<u>21-1</u>
<u>22</u>	<u>DRY TYPE AUXILIARY TRANSFORMER .....</u>	<u>22-1</u>

<u>23</u>	<u>OIL TYPE AUXILIARY TRANSFORMER .....</u>	<u>23-1</u>
<u>24</u>	<u>GENERAL ELECTRICAL TOOLS &amp; INSTRUMENTS.....</u>	<u>24-1</u>
<u>25</u>	<u>CATHODE RAY OSCILLOSCOPE .....</u>	<u>25-1</u>
<u>26</u>	<u>CIRCUIT BREAKER OPERATION ANALYSER (WITH DCRM KIT) .....</u>	<u>26-1</u>
<u>27</u>	<u>AUTOMATIC CAPACITANCE AND TAN<math>\delta</math> KIT .....</u>	<u>27-1</u>
<u>28</u>	<u>PRIMARY CURRENT INJECTION SET .....</u>	<u>28-1</u>
<u>29</u>	<u>HV-AC TEST SET .....</u>	<u>29-1</u>
<u>30</u>	<u>TRANSFORMER DC WINDING RESISTANCE MEASUREMENT KIT.....</u>	<u>30-1</u>
<u>31</u>	<u>UNIVERSAL RELAY TESTING KIT.....</u>	<u>31-1</u>
<u>32</u>	<u>INSULATING OIL FILTRATION PLANT .....</u>	<u>32-1</u>
<u>33</u>	<u>TURBINE OIL FILTRATION PLANT .....</u>	<u>33-1</u>
<u>34</u>	<u>ONLINE ULTRASONIC FLOW MEASUREMENT SYSTEM.....</u>	<u>34-1</u>
<u>35</u>	<u>GAS FILLING AND EVACUATION PLANT FOR GIS .....</u>	<u>35-1</u>
<u>36</u>	<u>SINGLE PHASE INVERTER.....</u>	<u>36-1</u>
<u>37</u>	<u>SINGLE PHASE UPS.....</u>	<u>37-1</u>
<u>38</u>	<u>CHARTLESS TYPE TEMPERATURE SCANNER.....</u>	<u>38-4</u>
<u>39</u>	<u>DIGITAL ROTOR TEMPERATURE INDICATOR.....</u>	<u>39-1</u>
<u>40</u>	<u>GENERAL PROVISION OF ILLUMINATION SYSTEM .....</u>	<u>40-1</u>
<u>41</u>	<u>MAIN LIGHTING DISTRIBUTION BOARD.....</u>	<u>41-1</u>
<u>42</u>	<u>HIGH MAST LIGHTING SYSTEM .....</u>	<u>42-1</u>
<u>43</u>	<u>PUMP STARTER PANEL .....</u>	<u>43-1</u>
<u>44</u>	<u>BATTERIES AND BATTERY CHARGERS .....</u>	<u>44-1</u>
<u>45</u>	<u>EPABX SYSTEM.....</u>	<u>45-1</u>
<u>46</u>	<u>TELEPHONE SET .....</u>	<u>46-1</u>

<u>47</u>	<u>PUBLIC ADDRESS SYSTEM .....</u>	<u>47-1</u>
<u>48</u>	<u>EXTENSION PANEL .....</u>	<u>48-1</u>
<u>49</u>	<u>BUS BARS.....</u>	<u>49-1</u>
<u>50</u>	<u>STARTER &amp; CONTACTORS .....</u>	<u>50-1</u>
<u>51</u>	<u>MCCB (MOULDED CASE CIRCUIT BREAKERS).....</u>	<u>51-1</u>
<u>52</u>	<u>MCB (MINIATURE CIRCUIT BREAKERS).....</u>	<u>52-1</u>
<u>53</u>	<u>FUSES .....</u>	<u>53-1</u>
<u>54</u>	<u>TERMINAL BLOCKS.....</u>	<u>54-1</u>
<u>55</u>	<u>PROTECTION &amp; AUXILIARY RELAYS .....</u>	<u>55-1</u>
<u>56</u>	<u>CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM .....</u>	<u>56-1</u>
<u>57</u>	<u>OFFICE EQUIPMENT .....</u>	<u>57-1</u>
<u>58</u>	<u>DIAL TYPE THERMOMETER (DTT) .....</u>	<u>58-1</u>
<u>59</u>	<u>RESISTANCE TYPE THERMOMETER (RTD) .....</u>	<u>59-1</u>
<u>60</u>	<u>KARL FISCHER TYPE MOISTURE MEASUREMENT KIT .....</u>	<u>60-1</u>
<u>61</u>	<u>REGENERATIVE DRY AIR SYSTEM .....</u>	<u>61-1</u>
<u>62</u>	<u>VACCUM PUMP FOR TRANSFORMER EVACUATION SYSTEM.....</u>	<u>62-1</u>

# 1 MV POWER CABLE

## 1.1 Scope of Work

The specification covers the design, manufacture, supply of MV Power Cable for use in various purposes at XXX Power station of NHPC Limited.

## 1.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IS 7098	Specification for cross linked polyethylene insulated PVC sheathed cables
2.	IS 8130	Specification for conductors for insulated electric cables and flexible cords

## 1.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

## 1.4 Functional Characteristics

Cables shall be capable of satisfactory operation under Power Supply System frequency variation of  $\pm 5\%$  and voltage variation of  $\pm 10\%$ .

The cables shall have the following properties:

- |      |                   |   |
|------|-------------------|---|
| i)   | Oxygen index      | Min. 29,                                  |
| ii)  | Smoke density     | Min. 40% light transmittance, (IEC 61034) |
| iii) | Acid gas          | Max. 20% by weight,                       |
| iv)  | Temperature index | Min 250°C at 21% of Oxygen                |
| v)   | Flame propagation | shall meet IEC 60332-1, IEEE 383.         |

## 1.5 Cable Construction

### 1.5.1 MV Power cables

MV Power cable shall be heavy duty, FRLSH, stranded circular copper conductor provided with conductor screening, cross-linked polyethylene (XLPE) insulated provided with insulation screening, extruded PVC type "ST2" inner sheathed, armoured and outer sheathed with extruded FRLSH PVC type "ST2".

The conductor screening shall be of extruded semi-conducting compound and insulation screening shall be of extruded semi-conducting compound followed by semi conducting tape & copper tape.

### 1.5.2 Specific Technical Parameter

Sl. No.	Parameter	Value
1.	Rated voltage	11 / 11 KV (UE) for 11 KV Cable 19 / 33 KV (E) for 33 KV Cable
2.	Conductor Material	Plain Copper (Class-2)
3.	Conductor Shape	Stranded Compacted Circular
4.	Type of Insulation	XLPE
5.	No. of Core	To Be specified by Power Station
6.	Continuous current carrying capacity	To Be specified by Power Station
7.	Cross section area of Conductor	To Be specified by Power Station
8.	Laying of cable	In Air / In Ground / In Duct
9.	Max. Temperature rise due to load	
a)	Normal Continuous Operation	90 Deg.C
b)	Short Circuit Operation	250 Deg.C

### 1.5.3 Cable identification

To facilitate easy identification of phases a colour scheme of red, yellow & blue for phases and black for neutral shall be adopted for cables.

All the cables shall carry manufacturer data in a permanent, legible manner at an interval of at least three (3) meter run. The manufacturer's data shall include the name, cable size, and voltage rating together with any other information. Permanent sequential marking to indicate length of the cable shall be embossed at every meter.

## **2 LV POWER CABLE**

### **2.1 Scope of Work**

The specification covers the design, manufacture, supply of LV Power Cable for use in various purposes at XXX Power station of NHPC Limited.

### **2.2 Standards and Regulations:**

The following standards with latest amendment would apply to the specification.

<b>Sl. No.</b>	<b>Standards</b>	<b>Description</b>
1.	IS 1554	Specification for PVC insulated (heavy duty) Electric cables
2.	IS 7098	Specification for cross linked polyethylene insulated PVC sheathed cables
3.	IS 8130	Specification for conductors for insulated electric cables and flexible cords
4.	IS 5831	Specification for PVC insulation and sheath of electric cables

### **2.3 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **2.4 Functional Characteristics**

Cables shall be capable of satisfactory operation under Power Supply System frequency variation of  $\pm 5\%$  and voltage variation of  $\pm 10\%$ .

The cables shall have the following properties:

- |      |                   |   |
|------|-------------------|---|
| i)   | Oxygen index      | Min. 29,                                  |
| ii)  | Smoke density     | Min. 40% light transmittance, (IEC 61034) |
| iii) | Acid gas          | Max. 20% by weight,                       |
| iv)  | Temperature index | Min 250°C at 21% of Oxygen                |
| v)   | Flame propagation | shall meet IEC 60332-1, IEEE 383.         |

### **2.5 Cable Construction**

#### **2.5.1 LV Power cables**

LV Power cable shall be of 1100 V Grade, heavy duty, FRLSH, stranded Aluminium / Copper conductor, cross-linked polyethylene (XLPE) / PVC insulated, extruded PVC type "ST2" inner sheathed and outer sheathed with extruded FR-LSH PVC type "ST2".

Normally all LV cables shall be un-armoured, however cables used in switchyard and any cable laid directly (without cable tray / pipe etc.) either underground or in air shall be of armoured type. The armouring shall always be earthed at one end to ensure that it cannot become live if a fault develops within the cable.

LT Power Cables for DC system shall be of copper only of 650 V Grade.

All the power cable used in fire protection system shall be fire survival cable designed to withstand 950 (nine hundred fifty) deg.C fire for at least three hours.

### 2.5.2 Specific Technical Parameter

Sl. No.	Parameter	Value
1.	Rated voltage	1100 V
2.	Conductor Material	Plain Copper (Class-2) / H2 / H4 grade Aluminium
3.	Conductor Shape	Stranded Compacted Circular (For Greater than 6 sq.mm Cable) / Stranded Non Compacted Circular (For up to & including 6 sq. mm Cable)
4.	Type of Insulation	XLPE (For Greater than 95 sq.mm Cable) / HR PVC Type-C as per IS: 5831 (For up to & including 95 sq. mm Cable)
5.	No. of Core	To Be specified by Power Station
6.	Continuous current carrying capacity	To Be specified by Power Station
7.	Cross section area of Conductor	To Be specified by Power Station
8.	Laying of cable	In Air / In Ground / In Duct
9.	Max. Temperature rise due to load	
a)	Normal Continuous Operation	90 Deg.C (XLPE) / 85 Deg.C (PVC)
b)	Short Circuit Operation	250 Deg.C(XLPE) / 160 Deg.C (PVC)

### 2.5.3 Cable identification

To facilitate easy identification of phases a colour scheme of red, yellow & blue for phases and black for neutral shall be adopted for cables.

All the cables shall carry manufacturer data in a permanent, legible manner at an interval of at least three (3) meter run. The manufacturer's data shall include the name, cable size, and voltage rating together with any other information. Permanent sequential marking to indicate length of the cable shall be embossed at every meter.

### **3 CONTROL AND INSTRUMENTATION CABLE**

#### **3.1 Scope of Work**

The specification covers the design, manufacture, supply of Control & Instrumentation Cable for use in various purposes at XXX Power station of NHPC Limited.

#### **3.2 Standards and Regulations:**

The following standards with latest amendment would apply to the specification.

<b>Sl. No.</b>	<b>Standards</b>	<b>Description</b>
1.	IS 1554	Specification for PVC insulated (heavy duty) Electric cables
2.	IS 7098	Specification for cross linked polyethylene insulated PVC sheathed cables
3.	IS 8130	Specification for conductors for insulated electric cables and flexible cords
4.	IS 5831	Specification for PVC insulation and sheath of electric cables

#### **3.3 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

#### **3.4 Functional Characteristics**

Cables shall be capable of satisfactory operation under Power Supply System frequency variation of  $\pm 5\%$  and voltage variation of  $\pm 10\%$ .

The cables shall have the following properties:

- i) Oxygen index Min. 29,
- ii) Smoke density Min. 40% light transmittance, (IEC 61034)
- iii) Acid gas Max. 20% by weight,
- iv) Temperature index Min 250°C at 21% of Oxygen
- v) Flame propagation shall meet IEC 60332-1, IEEE 383.

#### **3.5 Cable Construction**

##### **3.5.1 Control & Instrumentation cables**

Control & instrumentation cable shall be of 1100 V Grade, multicore, colour coded / numbered, FRLSH, annealed stranded high conductivity copper conductor, extruded HR-PVC type "C" insulated, extruded PVC type "ST2" inner sheathed and outer sheathed with extruded FR-LSH PVC type "ST2".

All the Control & Loop cable used in fire protection system shall be fire survival cable designed to withstand 950 (nine hundred fifty) deg.C fire for at least three hours.



### 3.5.2 Specific Technical Parameter

Sl. No.	Parameter	Value
1.	Rated voltage	1100 V
2.	Conductor Material	Electrolytic grade Copper stranded (Class-2) as per IS 8130
3.	Conductor Shape	Stranded Non Compacted Circular
4.	Type of Insulation	HR PVC Type-C as per IS: 5831
5.	No. of Core	To Be specified by Power Station
6.	Continuous current carrying capacity	To Be specified by Power Station
7.	Cross section area of Conductor	To Be specified by Power Station
8.	Laying of cable	In Air / In Ground / In Duct
9.	Max. Temperature rise due to load	
a)	Normal Continuous Operation	90 Deg.C (XLPE) / 85 Deg.C (PVC)
b)	Short Circuit Operation	250 Deg.C(XLPE) / 160 Deg.C (PVC)

### 3.5.3 Cable identification

Multi-core control cables shall be colour coded / numbered for identification of cores as per IS: 1554 1988 / IEC.

All the cables shall carry manufacturer data in a permanent, legible manner at an interval of at least three (3) meter run. The manufacturer's data shall include the name, cable size, and voltage rating together with any other information. Permanent sequential marking to indicate length of the cable shall be embossed at every meter.

## 4 5 KV INSULATION RESISTANCE TESTER

### 4.1 Scope of Work

The specification covers the supply of 5 KV Insulation Resistance Tester along with test lead set for use in various purposes at XXX Power station of NHPC Limited.

### 4.2 Standards and Regulations:

The following standards with latest amendment would apply to the Instruments.

Sl. No.	Standards	Description
1.	IEC 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
2.	IEC 61010-031	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test
3.	IEC 61326-1	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General

### 4.3 Functional Characteristics:-

The DC Insulation Resistance Tester shall meet the following minimum technical requirement:-

- i) Measuring range of 100K $\Omega$  to 10T $\Omega$  at variable test voltage from 50V to 5KV
- ii) Accuracy:  $\pm 5\%$ ,
- iii) Suitability for full suite of diagnostic tests such as Insulation resistance (IR), Polarisation index (PI), Dielectric Absorption Ratio (DAR), Step Voltage (SV), Dielectric discharge and ramp testing.
- iv) Advanced On-board memory for storage of result, on screen recall and real time clock for date / time stamped results
- v) Ability to stream data / download data to a PC / laptop via USB interface
- vi) Large LCD display with backlight for automatic display of results
- vii) Rechargeable battery on 250V, 50Hz AC supply with rapid charge facility
- viii) Operation from A.C source, in case of battery discharge
- ix) Enclosure rating of IP65
- x) Safety rating of CAT IV 600V at Maximum altitude of XXXX m (To be specified)
- xi) One set of Test lead of minimum 3 m with cable insulation rating of 12 KV DC (marked on cable).

## 5 10 KV INSULATION RESISTANCE TESTER

### 5.1 Scope of Work

The specification covers the supply of 10 KV Insulation Resistance Tester along with test lead set for use in various purposes at XXX Power station of NHPC Limited.

### 5.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IEC 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
2.	IEC 61010-031	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 031: Safety requirements for hand-held probe assemblies for electrical measurement and test
3.	IEC 61326-1	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General

### 5.3 Functional Characteristics:-

The 10 KV DC Insulation Resistance Tester shall meet the following minimum technical requirement:-

- i) Measuring range of  $100K\Omega$  to  $20T\Omega$  at variable test voltage from 50 to 10KV
- ii) Accuracy:  $\pm 5\%$ ,
- iii) Suitability for full suite of diagnostic tests such as Insulation resistance (IR), Polarisation index (PI), Dielectric Absorption Ratio (DAR), Step Voltage (SV), Dielectric discharge and ramp testing.
- iv) Advanced On-board memory for storage of result, on screen recall and real time clock for date / time stamped results
- v) Ability to stream data / download data to a PC / laptop via USB interface
- vi) Large LCD display with backlight for automatic display of results
- vii) Rechargeable battery on 250V, 50Hz AC supply with rapid charge facility
- viii) Operation from A.C source, in case of battery discharge
- ix) Enclosure rating of IP65
- x) Safety rating of CAT IV 600V at Maximum altitude of XXXX m (To be specified)
- xi) Two sets of Test lead each of minimum 3 m with cable insulation rating of 12 KV DC (marked on cable).

## **6 DIGITAL MULTIMETER**

### **6.1 Scope of Work**

The specification covers the supply of Digital Multimeters for use in various purposes at XXX Power station of NHPC Limited.

### **6.2 Functional Characteristics:-**

The Multimeter shall meet the following minimum technical requirement:-

- i) Accuracy:
  - a) DC:  $\pm 1\%$ ,
  - b) AC:  $\pm 1.5\%$ ,
  - c) Ohm:  $\pm 1\%$ .
- ii) Ranges:
  - a) Voltage: 60 mV...1000 V in several steps,
  - b) Current :1.5 mA...30 A in several steps,
  - c) Resistance: upto...50 k Ohm.
- iii) Continuity audible test,
- iv) Diode test, capacitance measurement, frequency measurement,
- v) Hold display features,
- vi) Overload protection.

### **6.3 Standard Features**

- i) The multimeters shall have Safety rating of CAT IV 600V at Maximum altitude of XXXX m (To be specified)
- ii) The multimeters shall be supplied with calibration certificate issued from Govt. approved laboratory.
- iii) The multimeters shall be supplied with measuring test leads.
- iv) The multimeters supplied shall have minimum period of one year warranty.

## **7 DEW POINT METER**

### **7.1 Scope of Work**

The specification covers the supply of Dew Point meter for use in various purposes at XXX Power station of NHPC Limited.

### **7.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **7.3 Functional Characteristics:-**

Dew point meter must be suitable to measure dew point of following gases;

- i) SF6 gas used (as insulation) in GIS (up to a pressure of 8 Bar)
- ii) N2 gas (a) In dry condition (dew pt. up to -55°C) stored in cylinders.  
(b) In wet condition, up to a pressure below one bar filled in a power transformer (or in a current transformer) prior to filling of oil.
- iii) Dry Air

The instrument shall be suitable to measure the dew point of Air, SF6 and N2 either at atmospheric pressure or at working pressure of gas filled in equipment and a suitable table/chart shall be supplied, if required, to convert dew point measured at atmospheric pressure to that at other pressures (up to 8 bar).

If instrument is suitable for low-pressure sample, the pressure regulating attachment shall also be supplied as part of the instrument.

If sensor of dew pt. meter is suitable for low-pressure sample only, it shall be suitably protected against entry of high-pressure gas to avoid its damage.

The portable/desktop model of the instrument is desired.

Dew point measuring range: – 60 deg C to 0 deg C

Measuring Accuracy ± 3 deg C

Input pressure Eight (08) bar

Display Digital – LCD/Red LED

Power Supply Input:

Mains (AC supply OR DC supply) OR Battery/cell operated

If AC supply operated, it shall be suitable for: 230 Volts. (±10%), 50 Hz.

### **7.4 Drawing & Manual:**

The supplier / bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, dimensions and characteristics of the system.
- ii) Calibration certificate of the instrument issued from Govt. approved lab.

## **8 WINDING RESISTANCE METER**

### **8.1 Scope of Work**

The specification covers the supply of Winding resistance meter along with test lead set for use in various purposes at XXX Power station of NHPC Limited.

### **8.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **8.3 Functional Characteristics:-**

The Winding Resistance meter shall be used for measuring DC winding resistance of the transformer/reactor where large inductance is present. The instruments shall meet the following minimum technical requirement:-

- i) The test kit shall be able to withstand inductive kicks from transformer winding. Variation in test current shall not result in loss of accuracy.
- ii) The display or resistance should be through direct LED/LCD without requiring any balancing of decades to obtain stable readings. It should employ four-point method and no lead compensation shall be required for measurement.
- iii) Built-in discharge circuit shall be provided to discharge the specimen when test is completed when current lead accidentally disconnects or when instrument power supply is lost.
- iv) Technical Parameters
  - a) Test current 25 Amp
  - b) Resolution 1 milli-Ohm
  - c) Range 0 to 100 ohms
  - d) Accuracy  $\pm 0.5\%$  of full scale reading or better
  - e) Open circuit voltage min. 30 Volts, DC
- v) Input supply of the kit shall be 230Volts AC, 50 Hz.
- vi) The instrument shall have built in memory storage and suitable port for PC communication.

### **8.4 Drawing & Manual:**

The supplier / bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, dimensions and characteristics of the system
- ii) Calibration certificate of the instrument issued from Govt. approved lab.

## **9 BATTERY ANALYSER**

### **9.1 Scope of Work**

The specification covers the supply of Battery Analyser along with test lead set for use in various purposes at XXX Power station of NHPC Limited.

### **9.2 Functional Characteristics:-**

The Battery analyser shall be used for maintenance, troubleshooting and performance testing of individual stationary batteries and battery banks.

- i) It should measure the internal battery resistance, dc and ac voltage, dc and ac current, ripple voltage, frequency and temperature.
- ii) Automatic or manual sequence testing of battery strings with automatic measurement storage including voltage, resistance and temperature.
- iii) All measured values should be automatically captured during testing and can be reviewed on the instrument before downloading analysis.

### **9.3 Standard Feature**

The Battery analyser shall meet the following minimum technical requirement:-

- i) Measuring range of 100K $\Omega$  to 20T $\Omega$  at variable test voltage from 50 to 10KV
- ii) Accuracy:  $\pm 5\%$ ,
- iii) The instrument shall have battery management software so that all measurement data, battery profile and analysis information can be used to easily generate reports.
- iv) It shall have USB port for fast data download to supplied data analysis and report management application software.
- v) Enclosure rating of IP40.
- vi) Safety rating of CAT III 600V at Maximum altitude of XXXX m (To be specified)

### **9.4 Drawing & Manual:**

The supplier / bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, dimensions and characteristics of the system
- ii) Calibration certificate of the instrument issued from Govt. approved lab.

## 10 BDV TEST KIT

### 10.1 Scope of work

The specification covers the design, manufacture and supply of BDV test kit for use at XXX Power station of NHPC Limited.

### 10.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	
1.	BS148	Recycled mineral insulating oil for transformers and switchgear - Specification
2.	IEC-60156	Insulating liquids - Determination of the breakdown voltage at power frequency - Test method

### 10.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 10.4 Functional Characteristics

High voltage insulation oil testing device, shall be an automatic testing device, freely programmable, for execution of test specifications according to IEC/VDE or other international test standards, complete with all accessories, suitable for:

- Test voltage: 0 - 100 kV AC,
- The test cell shall be as per IEC-156(latest revision).
- Required gauges for gap adjustment.
- The equipment shall be robust in design so that it gives desired performance even in adverse site conditions.
- Results shall be printed on the internal printer or transferred via the RS232 interface to PC
- Connection voltage: 230 V, 50 Hz.

Portable fully automatic oil test set kit is intended to be used for testing of Dielectric strength of insulating oils used in transformers and circuit breakers. The test voltage should be electronically controlled up to 100 KV.

Oil testing cell has Spherical and mushroom cell, dimensions and gap in accordance with is specifications with a gauge to calibrate the gap and faster switch-off time on flashover or fast tripping at dielectric breakdown (5 $\mu$ S).

The test set shall have the feature of fully automatic operation plus a built in printer to produce a hard copy of the test results.



The unit shall be suitable for laboratory use and it shall be assembled in a closed transparent hard and non-breakable container which shall be either rectangular cubicle shape and it shall be protected from outside sand, moisture etc

#### **10.5 Standard Features & Accessories**

Instrument shall have following minimum standard features –

- i) The set shall be provided with automatic voltage rise of 2 KV/second Automatic breaking at breakdown of oil and indication of break down voltage.
- ii) The set shall be provided with smooth and continuous control of output voltage between zero and maximum having no distortion of waveform.
- iii) The unit shall be fitted with preferable LCD/TFT/VGA display volt-meter and the volt meter should continue to indicate break-down voltage after circuit breaker trip till reset.
- iv) Audio sound and visual signal should indicate at the instant of sample failure.
- v) Indication for both supply "ON" and high voltage "ON" shall be available.

#### **10.6 Accessories**

- i) Vessel 400 ml assembly- 1 No,
- ii) Magnetic bead stirrers- 2 Nos,
- iii) Magnetic bead retriever-1 No,
- iv) Electrode spacing / Feeler gauge set 1, 2, 2.5, 2.54 mm, IEC60156 electrode Set includes: - 12.7 mm spherical- 2 nos ,36 mm mushroom -2 nos with electrode Set for testing as per IEC Standard, ASTM D877/1816 electrode set - 25.4 mm cylindrical (2 standard, and 2 none standard), 36 mm mushroom 2 Nos with electrode set for testing as per ASTM Standard,
- v) Printer paper, Power supply lead & Carry Bag

#### **10.7 Drawing & Manual:**

The supplier shall submit following information:-

- i) Test/ Calibration Certificate from approved Govt. lab for the offered Testing Equipment.
- ii) Constructional and Outline Dimensional drawings;
- iii) Installation, Operation & Maintenance Manual;

## 11 DGA TEST KIT

### 11.1 Scope of work

The specification covers the design, manufacture and supply of DGA test kit for use at XXX Power station of NHPC Limited.

### 11.2 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 11.3 Functional Characteristics

- i) Online Dissolved Gas (Multi-gas) Analyser along with all required accessories shall be provided for measurement & analysis of dissolved gases in the oil. Interpretations shall be as per IEC 60599 (latest amendment). The analyser shall meet following minimum requirement:-
  - Quick analysis of the oil samples for dissolved gases like H<sub>2</sub>, CO, CO<sub>2</sub>, CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, C<sub>2</sub>H<sub>4</sub>, C<sub>2</sub>H<sub>2</sub>, O<sub>2</sub> & N<sub>2</sub>.
  - Easy to use and facility to store the results and afterwards transfer of result to PC.
  - Analysis software with intelligent software for analysis of oil result as per various standards like IEEE, IEC, Duval triangle, Roger ratio etc. The analyser shall be supplied complete with all accessories, consumables, software etc.
- ii) The analyser should measure (not calculate) all above gases and should have 100% sensitivity. The equipment shall be IEC 61850 compliant to integrate with SCADA system. The results shall be communicated to control room or remote location (through SCADA) and shall be compared with the standard pre-set results to indicate the possible severe damage/failure.
- iii) Equipment should work on station auxiliary supply. In case other supply is required for the equipment then suitable converter shall be included. All the necessary power and control cables, communication cables, cable accessories as required shall be provided by the supplier.
- iv) The equipment shall connect to the transformer's main body in two locations. One connection is for the supply of oil from the transformer. Second connection is for the return of the oil to the transformer. The connecting oil lines must be of Stainless Steel rigid pipes or flexible hoses.
- v) The equipment shall be able to measure gas concentration and when downloaded should immediately compare it with user selected alarm & caution level for immediate display. The sampling rate shall be selectable as 2 or 4 or 6 or 12 hours etc. The equipment shall have inbuilt memory to store these results for complete one year even if sampling is done at the lowest interval.

- vi) The Equipment must have an automatic Calibration facility at fixed intervals. For calibration if anything required including cylinder must be mounted with the Equipment.
- vii) The technical feature of the equipment shall be as under: Accuracy +/-5% Repeatability +3% to 10% depending upon gases, Oil temperature range – 20 deg C to + 120 deg C External Temp. Range – 20 deg C to + 55 deg C, Humidity range 10 to 95 %, Operating Voltage 230 VAC; 50 Hz ( $\pm 20\%$  variation), Communications USB & IEC 61850 compliant
- viii) Software for fault indication and fault diagnostics shall include following:
  - a) Fault indication:
    - IEEE, IEC or user configurable levels of dissolved gases
    - Rate of change trending
  - b) Fault Diagnosis:
    - Key gases
    - Ratios (Rogers, IEC. etc.)
    - Duval's Triangle
- ix) The equipment shall be supplied with all necessary accessories required for carrying out DGA of oil sample complete in all respect as per the technical specification.

The following shall be also form a part of supply.

- a) Software
- b) Operation Manual (2 set for every unit),
- c) Software Manual and
- d) Compact disc giving operation procedures of Maintenance Manual & Troubleshooting instructions.
- e) Basic 8 Gas Monitor with Monitor Mounting Kit
- f) Additional Ten (10) nos. of filter (each type) and additional Two (2) no. of syringe (if applicable) to facilitate oil sampling and analysing with portable dissolve gas analyser
- g) Calibration Cylinder
- h) Bleed Fixture & Junction Box with 3.5ft. Cables
- i) Carrier gas tank regulator, dryer and supply lines
- j) Load Guide & Ambient Temperature Sensors
- k) Manual DGA sample port assembly
- l) Oil supply and return assembly
- m) Associated Software
- n) Carrier Gas Cylinder with 99.999% purity with gas regulator and pressure gauges
- o) Suitable SS Tubing of required dia and length for oil & gas
- p) Moisture Probe for monitoring Moisture
- q) Any other accessories required for with the supplied item other than what is specified.

**11.4 Drawing & Manual:**

The supplier shall submit following information:-

- i) Test/ Calibration Certificate from Govt. approved lab for the offered type Testing Equipment.
- ii) Constructional and Outline Dimensional drawings;
- iii) Installation, Operation & Maintenance Manual;

## 12 ONLINE VIBRATION MONITORING SYSTEM

### 12.1 Scope

The specification covers the design, manufacture, supply and installation of Online Vibration Monitoring System for use at XXX Power station of NHPC Limited.

The system shall comprise of followings:

- i) Non-contact proximity probes for dynamically monitor the motion of the generator / turbine shaft relative to the bearings. The location of the probe shall be as follows:
  - Two (2) nos. non-contact type proximity probes each located at all the guide bearings (Upper, lower, turbine guide bearing) to measure radial vibration in both axes.
  - Three (3) proximity probes at the thrust bearing bracket at suitable location 120 degree apart to monitor axial shaft vibration.
- ii) Velocity / acceleration type contact probes to monitor the absolute vibration on the stator and bearing covers. The location of the probe shall be as follows:
  - Two no. contact type probe each for all guide bearing to measure the structural vibration.
  - Four no. contact type installed at suitable locations 90 degree apart to monitor stator frame.

### 12.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IS 14773	Mechanical Vibration of non-reciprocating machines.

### 12.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

### 12.4 Functional Characteristics

A continuous on-line vibration monitoring system complete with sensors, input/output module, control/processor unit, relays, junction boxes, cabling and associated accessories for measuring, monitoring and data acquisition of shaft vibration/run-out shall be provided for each unit.

The probe shall have accuracy better than  $\pm 2.5\%$  and repeatability better than  $\pm 0.5\%$ .

The system shall be integrated with plant SCADA system for annunciation and data storage to plant data storage for long term trending. The systems shall have self-diagnostic feature.

## **12.5 Standard Features**

### **12.5.1 Vibration Monitoring system**

Instrument shall have following minimum standard features –

- i) Signal processing by microprocessor of latest generation.
- ii) All the modules like power supply, system monitors & vibration monitors as applicable, shall be supplied in flush panel mounted standard size rack. Any vacant position on the rack shall be fitted with a blanking plate. Adequate mounting hardware shall be supplied with the instrument.
- iii) Display device shall be an integral part of the vibration monitoring Instrument.
- iv) The vibration monitoring equipment shall be mounted on Turbine-generator gauge panel located in generator floor. The equipment shall be front flush mounting type.
- v) English language legends and display.
- vi) LCD digital display of adequate size.
- vii) Communication protocol (To be specified as per requirement).
- viii) Self-diagnosis checks & features.
- ix) Relay alarm contacts and analog output (To be specified as per requirement).

### **12.5.2 Analysis & Diagnostic Software**

The below mentioned facilities shall be available in the workstation to be viewed simultaneously or individually as required on real time basis:

- Vibration levels measured in all the bearings of a particular unit in numerical values with phase angles.
- To simultaneously view orbit plots of all bearing of a particular unit on the monitor on same reference axis.
- To view individual vibration signature simultaneously or individually for a particular unit.

The vibration analysis software shall be capable of the following:

- Real time, historical trend and bar graph of real time data.
- Correlating and analyzing all monitored vibration parameters of quick and easy machine diagnostics.
- Keep record of all vibration and alarm history.
- Provide graphical display of all monitored vibration parameters of one machine on same graph for easy comparison and correlation for diagnostics.
- Print outs of all graphs can be taken on a printer connected to the vibration monitoring workstation.
- Monitoring in all modes of generator operation from machine standstill to over speed.
- Fast Fourier transforms (FFT) plots for vibration analysis (harmonic analysis).
- Orbit plot displaying displacement of bearings with respect to the rotating center.

- Measurement and analysis of data at three selected time intervals.
- Shaft position and shaft center line.
- Automatic diagnostic software.
- Healthy condition of transducers, power supply etc. shall be available at vibration monitoring workstation.
- Measurement and analysis of absolute shaft vibration

**12.6 Installation & Commissioning Of VM Equipment**

The installation & Commissioning of the system shall include but not limited to following:-

- i) Supervision for Installation.
- ii) Supervision for Commissioning, calibration & testing of complete lot of Vibration monitor equipment covered under scope of supply for each generator.
- iii) Preparation and submission of test report on Vibration monitor equipment for each generator.
- iv) Training at site for customer's engineers.

**12.7 Drawing & Manual:**

The bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, schematic diagram, dimensions and characteristics of the system
- ii) Field installation/commissioning manual.
- iii) O & M Manual.

### **13 ONLINE AIRGAP MONITORING SYSTEM**

#### **13.1 Scope**

The specification covers the design, manufacture, supply and installation of Online Air-gap Monitoring System for use at XXX Power station of NHPC Limited.

The system shall comprise of followings for each set of generator:

##### **13.1.1 Air Gap Measuring Sensors**

The measuring sensors shall include:

- i) Air gap capacitive sensors with extension cable.
- ii) Installation kits for each sensors.
- iii) Other accessories as applicable.

##### **13.1.2 Air Gap Monitors**

Instrumentation rack for air gap monitors consists of-

- i) Air Gap Input Module
- ii) Air Gap Protection & Display Unit
- iii) Power Supply Module
- iv) Alarm & Relay Module

##### **13.1.3 Data Acquisition System**

All networking hardware, cables, accessories etc. for integration of all AGMS units with engineering work station & Plant SCADA.

#### **13.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

#### **13.3 Functional Characteristics**

The air gap sensors must be capacitive type only with one plate of the capacitor being formed by the air gap sensors mounted on the stator and other plate being formed by the rotor poles. The capacitive air gap sensor is permanently installed in the air gap on the stator core/iron packets of the stator inside wall. Operating temperature of the sensor shall be in the range of 0 to 125 °C. The system shall be described for no. of sensors as per section-2. The sensor shall be immune to generator magnetic field and oil, vapour, humidity & dust inside generator. A synchronization probe used for rotor pole reference purpose shall be installed near the generator shaft at suitable location. The cables / leads from the synchronization probe to the wall mounted enclosure shall be routed in a protective conduit. The placement of conduits shall not interfere with normal operation and maintenance of the generator. The conduit shall be fastened securely to the stator frame to prevent movement due to vibration. All the conduits shall be liquid seal tight. The conduit filling factor will be decided during detailed engineering.

Air gap sensors shall generally comply with following requirements-



- Range : 20- 50 mm
- Type of lead/cable between sensor & junction box: Triaxial cable

### **13.3.1 Analysis & Diagnostic Software**

A latest state of art analysis and diagnostic software shall be supplied and installed on engineering work station. The Software shall be used for baseline monitoring of rotating machinery. It shall trend various parameters of air gap, display alarm status, and inform of instrumentation status. The software shall allow for continuous data acquisition and monitoring. Monitored values, parameter trends and alarm status screens shall be displayed at a press of a button on the Control Panel. The software shall provide on-screen annunciation of alarm status.

The system shall be capable of :

- Background automatic acquisition of data for trending
- On-screen warning of alarms per unit and per input
- Trending graphs displays
- Automatic data storage to provide tracking of pre- and post-alarm measurements
- A polar view of the rotor and stator providing information about roundness and eccentricity of both rotor and stator.
- Toggle capability from top air gap view to bottom air gap view.
- A signature display of the minimum air gap of each rotor pole over one revolution.
- An average air gap function providing a programmable and automatic air gap trending measurement.
- Polar display showing at least 20 turns before and 20 turns after an alarm has been detected by the system.

### **13.4 Installation & Commissioning Of AGMS Equipment**

The installation & Commissioning of the system shall include but not limited to following:-

- Supervision for Installation .
- Supervision for Commissioning, calibration & testing of complete lot of AGMS equipment covered under scope of supply for each generator.
- Preparation and submission of test report & as built drawings on AGMS equipment for each generator.
- Training at site for customer's engineers.
- Interpretation of air gap readings.

### **13.5 Drawing & Manual:**

The bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, schematic diagrams dimensions and characteristics of the system
- ii) Field installation/commissioning manual.
- iii) O & M Manual.

## 14 ONLINE PARTIAL DISCHARGE MEASUREMENT SYSTEM

### 14.1 Scope

The specification covers the design, manufacture, supply and Installation of Online Partial Discharge Measurement System for use at XXX Power station of NHPC Limited.

The system shall comprise of followings for each set of generator:

- i) Partial Discharge Couplers (Quantity as per Requirement) with appropriate length of HT & LT cables per coupler, termination box, connectors for termination of cables and insulating materials for insulation of HT joints.
- ii) Partial Discharge Analyser
- iii) One set of latest version of Microsoft window based PD Software for diagnosis & analysis of P.D. data and Predictive maintenance software
- iv) One set of networking hardware, cables and other networking accessories like cable conduits, junction boxes etc. for networking of plant SCADA & engineering workstation with all PD monitors.

Any other item, which is not specifically stated, but essentially required for installation & trouble free operation of the system shall also, deemed to have been included in the supplier's scope without any additional cost to purchaser.

### 14.3 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IEC 60034-27-02	On-line partial discharge measurements on the stator winding insulation of rotating electrical machines

### 14.4 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m)

### 14.5 Functional Characteristics

The system shall be a proven partial discharge analysis (PDA) system for continuous on-line monitoring of the condition of stator winding insulation without an interruption in the operation of the machine. The PDA system shall not, in any way, compromise the integrity and safety of the machine. The system shall be complete in all respect covering the major items mentioned in the specification.

#### 14.5.1 Partial Discharge Couplers

Partial discharge couplers shall be of capacitance type of proven design and shall meet the following requirements:

- Capable of operating up to class 'F' temperature limits.
- Couplers shall have resistance to electrical tracking.
- HV lead between coupler and generator bus ring (shall be as short as possible and shall be of low inductance and adequate ground) must be supplied with each coupler to ensure low inductance.
- Coupler shall allow for proper interpretation of PD activity within the generator and the corresponding recommendations.
- Coupler shall be immune to noise

#### **14.5.2 Partial Discharge Analyzer**

Partial Discharge Analyzer shall be PC compatible with built in tester and shall have provision for connecting to all the PD couplers of one generator for measurement of PD activity along with necessary cables for connections from Analyzer to termination box. P. D. Analyser shall be suitable for Continuous on line measurement of Partial Discharges and & shall meet the technical specification.

- Coupler shall have inbuilt reference sensor signal.
- PD Coupler leads shall be wired upto termination box.
- No. of PD coupler – (To be specified as per Requirement)
- Must cover 360° phase window with suitable resolution.
- Communication protocol suitable for connection to SCADA & Engineering Work Station.
- 2 nos. electrical alarm contacts

#### **14.5.3 Partial Discharge Analysis Software**

Latest version of Microsoft window based PD Software for diagnosis & analysis of P.D. data and predictive maintenance software shall be supplied with P. D. Monitor for complete data acquisition, controlling & analyzing of partial discharge activities. The software supplied shall be suitable for WINDOW'S latest configuration operating system and will be installed on engineering works station of power house. The software shall be proven, state of art and user friendly. The software should provide graphical displays and should have necessary diagnostic features to generate statistical and diagnostic reports. All PD units of power plant will be networked with plant SCADA and Engineering Work Station. The Engineering Work Station will be used for trending and analysis of PD data.

#### **14.5.4 Mounting and Insulation Kit**

The kit shall be complete with all hardware, coaxial cables for HT & LT connections and other components necessary to establish & insulate the high voltage connections with the stator winding, as well as the signal connections from couplers to termination box. Each signal cable shall be terminated in a shield grounding assembly at the coupler end & termination box end to reduce partial discharge losses and to prevent pick-up of external discharges/disturbances, so as to improve overall response of partial discharge analyzer. A separate free standing/wall mounted panel will be provided.

#### **14.5.5 PDA Termination Box**

Weather proof termination box as per NEMA Standard, Class-4, provided with protection circuitry to prevent build up of hazardous

voltage levels on any part of the box at any time and suitable for termination of LT connection from PD couplers along with necessary hardware for cable termination and mounting of termination box on concrete wall.

**14.6 Installation & Commissioning of the PD Equipment**

The installation & Commissioning of the system shall include but not limited to following:-

- Supervision for Installation.
- Supervision for Commissioning, calibration & testing of complete set of PD equipment covered under scope of supply for each generator.
- Preparation and submission of test report on PD equipment for each generator.
- Training at site for customer's Engineers.

**14.7 Drawing & Manual:**

The bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, dimensions and characteristics of the system.
- ii) Field installation/commissioning manual.
- iii) O & M Manual.

## **15 ONLINE SILT MONITORING SYSTEM**

### **15.1 Scope**

The specification covers the design, manufacture, supply and Installation of Online Silt Monitoring System to indicate & record the silt content of water passing through the tailrace of XXX Power station of NHPC Limited.

### **15.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **15.3 Functional Characteristics**

The silt measuring instruments shall be capable of measuring instantaneous silt content in parts per million (ppm) by volume, with error not to exceed +/- 2 %. Output shall be indicated on digital indicator, with serial output for SCADA system.

Instrument shall have following features –

- The Instrument shall be based on Optical Technology (Laser/Infrared)
- The instrument shall have a measuring range of 10-8000 (ppm by Volume)
- The instrument shall have an accuracy of +/- 2% of the reading or +/- 20 (ppm by Volume), whichever is greater.
- The instrument shall have provision of Data Logging and Serial Interface to SCADA system.
- The instrument shall have backlit Graphical Display.
- The Sensor shall have Automatic Self Diagnostic Facility.
- The instrument shall have RS 232 interface with Memory Back up and the enclosure should be NEMA 4X protected.

### **15.4 Installation & Commissioning Of VM Equipment**

The installation & Commissioning of the system shall include but not limited to following:-

- i) Supervision for Installation.
- ii) Supervision for Commissioning, calibration & testing of complete lot of Silt Monitoring equipment covered under scope of supply .
- iii) Preparation and submission of test report on Silt monitor equipment for Turbine.
- iv) Training at site for customer's engineers.

### **15.5 Drawing & Manual:**

The bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, schematic diagram, dimensions and characteristics of the system

- ii) Field installation/commissioning manual.
- iii) O & M Manual.

## 16 CIRCUIT BREAKER

### 16.1 Scope of Work

The specification covers the design, manufacture, supply of Circuit Breaker for use in various purposes at XXX Power station of NHPC Limited.

### 16.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IEC 62271-100	High-voltage switchgear and control gear - Part 100: High-voltage alternating-current circuit-breakers
2.	IEC 60427	Report on Synthetic testing of high voltage alternating Current Circuit breakers
3	IEC 60376 – 2005 Edition	Specification of technical grade sulphur hexafluoride (SF6) for use in electrical equipment

### 16.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 16.4 Functional Characteristics

#### 16.4.1 Circuit Breakers

The circuit breakers shall be of SF6 type. The circuit breaker of 220 KV & 400 KV systems shall be suitable for single pole operation and circuit breaker of 132 KV & 66 KV systems shall be suitable for three-pole operation. The breaker shall have single pressure interrupter / common interrupter unit per phase. The operating mechanism shall be spring / spring type or any other which have the proven operational performance subject to the employer's approval.

The interrupter and operating drive should be simple and sturdy conforming to C2, M2 class complying with T100 & L75 without maintenance respectively as per IEC 62271-100. The mechanism shall be trip free mechanically or electrically with anti-pumping device. SF6 circuit breakers shall conform to IEC-62271. Sufficient auxiliary contacts of the breakers shall be provided for the local and remote indications, the performance of various control and protection schemes and the interlocking scheme. Alarm and cut-off contacts for mechanism faults and gas pressure loss shall also be provided.

The circuit breaker shall be designed to minimize switching over voltages and also to be suitable for out-of-phase switching. The specified arc interruption performance must be consistent over the entire operating range, from line-charging currents to full short-circuit currents.

The circuit breaker shall be capable of being operated locally or from remote through UCB / LCB/ plant SCADA.

**16.4.2 Specific Technical Parameter**

Sl. No.	Particulars	Value			
<b>A</b>	<b>System Parameter</b>				
1.	Nominal Voltage, KV (r.m.s)	66	132	220	400
2.	Rated Voltage, KV (r.m.s)	72.5	145	245	420
3.	Rated Frequency (HZ)	50	50	50	50
4.	Rated short duration power frequency withstand voltage, , KV (r.m.s)				
4.1	against Ground	140	275	460	610
4.2	across the isolating distance	160	315	530	610
5.	Rated lightning impulse with stand voltage, KV (Peak)				
5.1	against Ground	325	650	1050	1425
5.2	across the isolating distance	375	750	1200	1425 (+240)
6.	Rated Switching impulse with stand voltage, KV (Peak)				
6.1	against Ground	N/A	N/A	N/A	1050
6.2	across the isolating distance	N/A	N/A	N/A	1050 (+345)
7.	Partial discharge of switchgear assembly at highest voltage for equipment, pc	<10	<10	<10	<10
8.	Rated short time withstand current (kA, r.m.s) for 1 Sec	40	40	50	63
9.	Rated Peak withstand current, (kA, Peak)	100	100	125	157.5
10.	Rated control voltage DC, V	220 V + 10% / -10% (-20% for trip coils)			
11.	Auxiliary AC supply, 3 phase, V	415 ± 10% V			
12.	Degree of Protection	IP 55			
<b>B</b>	<b>Circuit Breaker</b>				
1.	Type	SF6	SF6	SF6	SF6
2.	Operating mechanism	Three Phase operation		Single Phase operation	
3.	Rated Continuous Current, A	To Be Specified by Power Station			
4.	Rated short circuit breaking current kA (r.m.s)	40	40	50	63
5.	Rated short circuit making current, kA (peak)	100	100	125	167.5



Sl. No.	Particulars	Value			
6.	Rated line charging breaking current capacity, A	10 A	50 A	125 A	400 A
7.	First-pole-to clear factor	1.5	1.5	1.3	1.3
8.	Closing time	< 100 ms.	< 100 ms.	< 100 ms.	< 100 ms.
9.	Total break time for any current up to the rated breaking current	< 45 ms	< 45 ms	< 45 ms	< 45 ms
10.	Rated operating duty cycle	O-3min-CO-3 min-CO			
11.	No of trip coils	2	2	2	2
12.	Maximum Gas leakage rate (%) of the respective volume, per year	0.5%	0.5%	0.5%	0.5%
13.	Terminal Connectors suitability	Type of switchyard conductor to Be specified by Power Station			

### 16.5 Name Plate

The equipment shall have a rating plate with the information required by relevant IEC i.e. at least the following:

- Manufacturer's name
- Type number
- Serial number
- Rated Voltage
- Rated impulse withstand voltage
- Rated power frequency withstand voltage
- Rated frequency
- Rated current
- Rated short circuit breaking current
- Rated short time current (r.m.s), & duration.

## 17 OUTDOOR CURRENT TRANSFORMER

### 17.1 Scope of Work

The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery of Outdoor Current Transformer complete with all fittings & accessories at XXX Power station of NHPC Limited.

### 17.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IEC 61869	Instrument transformers

### 17.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

### 17.4 Functional Characteristics

#### 17.4.1 Constructional Features

- The CT shall be of the outdoor type, single phase, live tank type, oil immersed, self-cooled shaded porcelain bushing, hermetically sealed and suitable for operating in the tropical conditions with maximum ambient temperature.
- The CT shall be suitable for upright mounting on steel structures and shall preferably be suitable for horizontal transportation.
- The CT shall be complete with all accessories like primary & secondary terminals, terminal connectors, weather proof terminal box for secondary connection, lifting lugs, grounding terminals, oil sight glass, filling & draining plugs and name plate.
- The CT shall be filled up with insulating oil of characteristic as per latest IS: 335.
- Material for Primary and Secondary winding shall be of Copper
- Extended primary current shall be rated for 120% of normal current.
- Polarity shall be indelibly marked on each primary and secondary terminal.
- The current transformer shall be provided with suitable test tap for measurement of capacitance, tan delta as well as partial discharges.
- The CT secondary terminals shall be brought out in a weather-proof terminal box with a rating not less than IP 55.
- Facility shall be provided for short-circuiting and grounding of the C.T. secondary terminals inside the terminal box

- The terminal box shall be provided with removable gland plate and gland (s) suitable for 1100 volts grade 6 Sq. mm stranded copper conductor cable.
- The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing / locking arrangement and shall be suitable to prevent penetration of moisture and rainwater.
- A schematic drawing indicating the connections shall be provided in the interior of the Terminal box.
- The terminal blocks shall be stud-type and provided with ferrules, indelibly marked or numbered. The terminals shall be rated for not less than 10 Amps.
- All terminals shall be clearly marked with identification number to facilitate connection to external wiring
- The instrument security factor of metering core shall be low enough and not greater than '5'
- The C.T. shall be provided with non-corrosive, legible nameplate with the information, specified in the relevant standards, duly engraved / punched on it.

#### 17.4.2 Specific Technical Parameter

Sl. No.	Particulars	Value			
<b>A</b>	<b>System Parameter</b>				
1.	Nominal Voltage, KV (r.m.s)	66	132	220	400
2.	Rated Voltage, KV (r.m.s)	72.5	145	245	420
3.	Rated Frequency (HZ)	50	50	50	50
4.	Rated short duration power frequency withstand voltage, KV (r.m.s)				
4.1	Primary Winding	140	275	460	630
4.2	Secondary Winding	3	3	5	5
5.	Rated lightning impulse with stand voltage, KV (Peak)	325	650	1050	1425
6.	Rated Switching impulse with stand voltage, KV (Peak)	N/A	N/A	N/A	1050
7.	Minimum Creepage Distance, mm	1812	3625	6125	10500
8.	Partial discharge of switchgear assembly at highest voltage for equipment, pc	<10	<10	<10	<10
9.	Rated short time withstand current (kA, r.m.s) for 1 Sec	40	40	50	63
10.	Rated Peak withstand current, (kA, Peak)	100	100	125	157.5

<b>Sl. No.</b>	<b>Particulars</b>	<b>Value</b>
<b>B</b>	<b>CT Details</b>	
1.	Mounting details	To be specified by Power Station
2.	Terminal Connectors suitability	Type of switchyard conductor to Be specified by Power Station
3.	No. of Core per CT	To be specified by Power Station
4.	Core wise Current Ratio	To be specified by Power Station
5.	Core wise application / Purpose	Protection / Metering (To be specified by Power Station)
6.	Accuracy Class	PS / 5P20 (For Protection) 0.2 / 0.2S (For metering)
7.	CT Burden	To be specified by Power Station
8.	Minimum Knee Point Voltage	To be specified by Power Station
9.	Maximum Excitation current at Knee Point Voltage	To be specified by Power Station

## 18 OUTDOOR POTENTIAL TRANSFORMER

### 18.1 Scope of Work

The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery of Outdoor Potential Transformer complete with all fittings & accessories at XXX Power station of NHPC Limited.

### 18.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IEC 61869	Instrument transformers

### 18.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

### 18.4 Functional Characteristics

#### 18.4.1 Constructional Features

- The PT shall be of the electromagnetic, outdoor type, single phase, oil filled, self-cooled shaded porcelain bushing, hermetically sealed and suitable for operating in the tropical conditions with maximum ambient temperature.
- The PT shall be suitable for upright mounting on steel structures and shall preferably be suitable for horizontal transportation.
- The PT shall be complete with accessories like terminal connector for primary connection, weather- proof terminal box for secondary connection, lifting lugs, grounding terminals, oil sight glass, filling & draining plugs and name plate.
- The PT shall be filled up with insulating oil of characteristic as per latest IS: 335.
- Coils used shall be of Copper
- PT shall be hermetically sealed to eliminate breathing and to prevent ingress of air and moisture into the tank.
- The P.T. secondary terminals shall be brought out through fuse of suitable rating in a weather proof terminal box with a rating not less than IP 55 for easy access.
- The terminal box shall be provided with removable gland plate and gland (s) suitable for 1100 volts 4 sq. mm grade stranded copper conductor cable.
- The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing / locking

arrangement and shall be suitable to prevent penetration of moisture and rainwater.

- A schematic drawing indicating the connections shall be provided in the interior of the Terminal box.
- All terminals shall be clearly marked with identification number to facilitate connection to external wiring
- The PT shall be provided with non-corrosive, legible nameplate with the information, specified in the relevant standards, duly engraved / punched on it.

#### 18.4.2 Specific Technical Parameter

Sl. No.	Particulars	Value			
<b>A</b>	<b>System Parameter</b>				
1.	Nominal Voltage, KV (r.m.s)	66	132	220	400
2.	Rated Voltage, KV (r.m.s)	72.5	145	245	420
3.	Rated Frequency (HZ)	50	50	50	50
4.	Rated short duration power frequency withstand voltage, KV (r.m.s)				
4.1	Primary Winding	140	275	460	630
4.2	Secondary Winding	3	3	5	5
5.	Rated lightning impulse with stand voltage, KV (Peak)	325	650	1050	1425
6.	Rated Switching impulse with stand voltage, KV (Peak)	N/A	N/A	N/A	1050
7.	Minimum Creepage Distance, mm	1812	3625	6125	10500
8.	Partial discharge of switchgear assembly at highest voltage for equipment, pc	<10	<10	<10	<10
9.	Rated short time withstand current (kA, r.m.s) for 1 Sec	40	40	50	63
10.	Rated Peak withstand current, (kA, Peak)	100	100	125	157.5
<b>B</b>	<b>CVT Details</b>				
1.	Mounting Details	To be specified by Power Station			
3.	Terminal Connectors suitability	Type of switchyard conductor to Be specified by Power Station			
4.	No. of Core per CVT	To be specified by Power Station			
5.	Core wise Voltage Ratio	132/ $\sqrt{3}$ kV / (110/ $\sqrt{3}$ ) V / (110/ $\sqrt{3}$ ) V / (110/ $\sqrt{3}$ ) V (To be specified by Power Station)			

<b>Sl. No.</b>	<b>Particulars</b>	<b>Value</b>
6.	Core wise application	Protection / Metering / Synchronising (To be specified by Power Station)
7.	Accuracy Class	3P (For Protection) 0.2 for metering
8.	CT Burden	To be specified by Power Station
9.	Voltage Factor	1.5 for 30 s 1.2 for continuous

## 19 OUTDOOR CAPACITIVE VOLTAGE TRANSFORMER

### 19.1 Scope of Work

The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery of Outdoor Capacitive Voltage Transformer complete with all fittings & accessories at XXX Power station of NHPC Limited.

### 19.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IEC 61869	Instrument transformers

### 19.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

### 19.4 Functional Characteristics

#### 19.4.1 Constructional Features

- The CVT shall be of the outdoor type, single phase, oil filled, self-cooled shaded porcelain bushing, hermetically sealed and suitable for operating in the tropical conditions with maximum ambient temperature.
- The CVT shall be suitable for upright mounting on steel structures and shall preferably be suitable for horizontal transportation.
- The CVT shall be complete with accessories like terminal connector for primary connection, weather- proof terminal box for secondary connection, lifting lugs, grounding terminals, oil sight glass, filling & draining plugs and name plate.
- The CVT shall be filled up with insulating oil of characteristic as per latest IS: 335.
- Material for Primary and Secondary winding shall be of Copper
- CVT shall be hermetically sealed to eliminate breathing and to prevent ingress of air and moisture into the capacitor stack and into the tank of Capacitor Voltage Transformer. The tank shall have a built-in-provision to dissipate any excessive internal pressure.
- The CVT shall consist of coupling capacitive dividers and electromagnetic units and shall be suitable for coupling the carrier equipment to the overhead lines.
- The CVT shall be suitable for high frequency (HF) coupling required for power line carrier communication
- The coupling of CVT shall be suitable for the entire carrier frequency range of 40 KHz to 500 KHz. Necessary arrangement for preventing the HF signal to flow to the other circuits shall be provided.



- The CVT secondary shall be protected by HRC cartridge type fuses for all the windings
- The HF terminal shall be kept earthed when not used for PLCC purpose. Earthing link with fastener to be provided for HF terminal
- The CVT secondary terminals shall be brought out in a weather-proof terminal box with a rating not less than IP 55.
- The terminal box shall be provided with removable gland plate and gland (s) suitable for 1100 volts grade 4 Sq. mm stranded copper conductor cable.
- The terminal box shall be provided with a door in front so as to have easy access of secondary terminals. The door shall have a sealing / locking arrangement and shall be suitable to prevent penetration of moisture and rainwater.
- A schematic drawing indicating the connections shall be provided in the interior of the Terminal box.
- All terminals shall be clearly marked with identification number to facilitate connection to external wiring
- The CVT shall be provided with non-corrosive, legible nameplate with the information, specified in the relevant standards, duly engraved / punched on it.

#### 19.4.2 Specific Technical Parameter

Sl. No.	Particulars	Value			
<b>A</b>	<b>System Parameter</b>				
1.	Nominal Voltage, KV (r.m.s)	66	132	220	400
2.	Rated Voltage, KV (r.m.s)	72.5	145	245	420
3.	Rated Frequency (HZ)	50	50	50	50
4.	Rated short duration power frequency withstand voltage, KV (r.m.s)				
4.1	Primary Winding	140	275	460	630
4.2	Secondary Winding	3	3	5	5
5.	Rated lightning impulse with stand voltage, KV (Peak)	325	650	1050	1425
6.	Rated Switching impulse with stand voltage, KV (Peak)	N/A	N/A	N/A	1050
7.	Minimum Creepage Distance, mm	1812	3625	6125	10500
8.	Partial discharge of switchgear assembly at highest voltage for equipment, pc	<10	<10	<10	<10
9.	Rated short time withstand current (kA, r.m.s) for 1 Sec	40	40	50	63
10.	Rated Peak withstand current, (kA, Peak)	100	100	125	157.5

Sl. No.	Particulars	Value
<b>B</b>	<b>CVT Details</b>	
1.	Mounting Details	To be specified by Power Station
3.	Terminal Connectors suitability	Type of switchyard conductor to Be specified by Power Station
4.	No. of Core per CVT	To be specified by Power Station
5.	Core wise Voltage Ratio	$132/\sqrt{3}$ kV / $(110/\sqrt{3})$ V / $(110/\sqrt{3})$ V / $(110/\sqrt{3})$ V (To be specified by Power Station)
6.	Core wise application	Protection / Metering / Synchronising (To be specified by Power Station)
7.	Accuracy Class	3P (For Protection) 0.2 for metering
8.	CT Burden	To be specified by Power Station
9.	Voltage Factor	1.5 for 30 s 1.2 for continuous

## 20 OUTDOOR ISOLATOR

### 20.1 Scope of Work

The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery of Outdoor Isolator with / without earth switch complete with all fittings & accessories at XXX Power station of NHPC Limited.

### 20.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IEC 62271-102	High-voltage switchgear and control gear — Part 102 : Alternating current Disconnectors and earthing switches
2.	IS 9921	Specification for alternating current Disconnectors (Isolators) and earthing switches for voltages above 1000 v

### 20.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 20.4 Functional Characteristics

#### 20.4.1 Constructional details

- Isolators shall be complete with provision for electrical / mechanical interlock, with insulators, auxiliary contact switches, position indicating device, base frames, linkages operating mechanism, control cabinet, arcing horns (wherever necessary) etc.
- Isolators shall be outdoor and off-load type.
- Isolator shall be placed on rigid, self-supporting galvanized steel base with holes & Bolts of proper size and designed to be mounted on rigid & self supporting structure.
- Isolator shall be gang operated through motor from local as well as from remote control panel. There should be provision for mechanical operation by hand of isolator locally.
- Isolator shall be provided with gang operated Earth switch. The earthing switches should be of non-ferrous materials especially of the same material as that of main switch assembly and able to carry the same fault current as assigned to the main disconnecter and withstand the dynamic stresses.
- Isolators shall have heavy duty self-aligning and self-cleaning type high pressure contacts. The contacts shall be made of hard drawn electrolytic copper. The high pressure type contacts shall wipe the contact surface

during opening and closing without causing any scouring or abrasion on the contact surface.

- The male arm and female arm of the isolator shall be made from tube of high conductivity hard drawn electrolytic copper of required size and thickness.
- Earth switch wherever provided shall be constructional interlocked as well as electrically interlocked so that earth switch can be operated only when the main isolator is open and vice-versa.
- Flexible conductor of adequate section shall be provided at the lower end of the vertical operating shaft of earth switch for connection to station earthing system.
- Arcing horn/guiding horn/Corona control ring shall be provided in all isolator of 420KV Class and line side isolator of other voltage class isolator
- Isolator and earth switches shall be capable of withstanding the dynamic and thermal effect of maximum short circuit current of the system in their closed position. They shall be constructed such that they do not open under influence of short circuit current.

#### 20.4.2 Specific Technical Parameter

Sl. No.	Particulars	Value			
<b>A</b>	<b>System Parameter</b>				
1.	Nominal Voltage, KV (r.m.s)	66	132	220	400
2.	Rated Voltage, KV (r.m.s)	72.5	145	245	420
3.	Rated Frequency (HZ)	50	50	50	50
4.	Rated short duration power frequency withstand voltage, KV (r.m.s)				
4.1	between phases & ground	140	275	460	520
4.2	across the isolating distance	160	315	530	610
5.	Rated lightning impulse with stand voltage, KV (Peak)				
5.1	between phases & ground	325	650	1050	1425
5.2	across the isolating distance	375	750	1200	1425 (+240)
6.	Rated Switching impulse with stand voltage, KV (Peak)				
6.1	against Ground	N/A	N/A	N/A	1050
6.2	across the isolating distance	N/A	N/A	N/A	900 (+345)
7.	Minimum Creepage Distance, mm	1812	3625	6125	10500
8.	Partial discharge of switchgear assembly at highest voltage for equipment, pc	<10	<10	<10	<10

<b>Sl. No.</b>	<b>Particulars</b>	<b>Value</b>			
9.	Rated short time withstand current (kA, r.m.s) for 1 Sec	40	40	50	63
10.	Rated Peak withstand current, (kA, Peak)	100	100	125	157.5
11.	Rated control voltage DC, V	220 V $\pm$ 10%			
12.	Auxiliary AC supply, 3 phase, V	415 $\pm$ 10% V			
13.	Degree of Protection	IP 55			
<b>B</b>	<b>Isolator details</b>				
1.	Mounting Details	To be specified by Power Station			
2.	Type	Triple poles, horizontal Centre rotating Double Break type / two pole horizontal centre (single) break type			
3.	Rated Continuous Current, A	To Be Specified by Power Station			
4.	Cantilever strength of support insulator (Kgf)	600	600	800	800
5.	Total operating time of isolator along with its operating mechanism	< 12 Sec	< 12 Sec	< 12 Sec	< 12 Sec
6.	Terminal Connectors suitability	Type of switchyard conductor to Be specified by Power Station			

## 21 OUTDOOR LIGHTNING ARRESTOR

### 21.1 Scope of Work

The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery of Outdoor Lightning Arrestor complete with all fittings & accessories at XXX Power station of NHPC Limited.

### 21.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

SI. No.	Standards	Description
1.	IEC 60099-4	Surge arresters - Part 4: Metal-oxide surge arresters without gaps for a.c. systems
2.	IS 3070- 3	Lightning Arresters for Alternating Current Systems, Part 3: Metal Oxide Lightning Arresters Without Gaps

### 21.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 21.4 Functional Characteristics

#### 21.4.1 Constructional details

- Lightning arrestors shall be of heavy duty, station class and gapless zinc Oxide type, hermetically sealed units, complete with insulating base, suitable for outdoor installation and designed to be mounted on rigid & self-supporting structure.
- Lightning arrestor shall be complete with discharge counter, leakage current meter, Pressure relief devices, and insulator sub-base and supporting structures.
- Self-contained discharge counters, suitably enclosed for outdoor use, shall be provided for each single pole unit and placed on the Arrestor Structure, but requiring no auxiliary or battery supply for operation.
- The surge counter shall be IP55 class, 6 digit cyclometer at least 5 counts / sec.
- Suitable leakage current monitor on each pole of the arrestors with appropriate connections shall be supplied to measure leakage currents.
- The readings of Cyclometer counter & leakage current (Milli-Ammeter) shall clearly visible through an inspection window. The inspection window shall be sealed to prevent ingress of moisture
- The grading ring on each complete arrester for proper stress distribution shall be provided, if required, for attaining all the relevant technical parameters

#### 21.4.2 Specific Technical Parameter

Sl. No.	Particulars	Value			
<b>A</b>	<b>System Parameter</b>				
1.	Nominal system Voltage, KV (r.m.s)	66	132	220	400
2.	Highest system Voltage, KV (r.m.s)	72.5	145	245	420
3.	Rated Frequency (HZ)	50	50	50	50
4.	Rated short duration power frequency withstand voltage, KV (r.m.s)	140	275	460	630
5.	Rated lightning impulse with stand voltage, KV (Peak)	325	650	1050	1425
6.	Rated Switching impulse with stand voltage, KV (Peak)	N/A	N/A	N/A	1050
7.	Minimum Creepage Distance, mm	1812	3625	6125	10500
8.	Rated short time withstand current (kA, r.m.s) for 1 Sec	40	40	50	63
9.	Rated Peak withstand current, (kA, Peak)	100	100	125	157.5
<b>B</b>	<b>Lightning arrestor details</b>				
1.	Mounting Details	To be specified by Power Station			
3.	Rated arrestor voltage, KV (r.m.s)	60	120	198	360
4.	Continuous operating voltage (COV) , KV (r.m.s)		102	168	306
5.	Rated nominal discharge current (8/20 micro second wave shape), kA	10	10	10	10
6.	Minimum thermal capability at rated voltage, KJ/KV	10	7	7	5
7.	Line Discharge Class	III	III	III	III
8.	Partial Discharge (pC) when energized at 1.05 times its continuous operating voltage.	<10	<10	<10	<10
9.	Cantilever strength of support insulator (Kgf)	600	600	800	800
10.	Terminal Connectors suitability	Type of switchyard conductor to Be specified by Power Station			

## 22 DRY TYPE AUXILIARY TRANSFORMER

### 22.1 Scope of Work

The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery of Auxiliary Transformer complete with cubicles and all necessary accessories such as bushings, off-circuit tap changer, CTs, instrumentation, fittings etc. at XXX Power station of NHPC Limited.

### 22.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification:

Sl. No.	Standards	Description
1.	IEC 60076-11	Dry Type Power transformers
3.	IEC 61869	Instrument transformer

### 22.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 22.4 Functional Characteristics

The Transformer shall be used as Unit Tap-off Transformer (UTT) / Unit Auxiliary Transformer (UAT) / Station Auxiliary Transformer (SAT) / Station Service Transformer (SST) etc..

Each Transformer shall be clearly identified with suitably located nameplate(s). Nameplates shall be furnished for all instruments, control switches, etc. Each section of an assembly shall have an identifying name plate placed near the top edge.

All secondary and control wiring shall be done with stranded copper wires, current transformer secondary leads shall not be less than 4.0 mm<sup>2</sup>. All control wiring within the assembly housing shall be installed at the manufacturer's premises. All connections shall be made with solder less lugs. All wires and connections to remote equipment shall be wired to terminal blocks.

The current transformer (if required) shall be single phase single core inductive type. It shall be mounted within the cubicles and shall comply with the requirements of relevant IEC 61869. The secondary windings of all current transformers shall be grounded at one point only and means shall be provided to facilitate the secondary windings to be short-circuited.

#### 22.4.1 Constructional details

The transformers shall be of the indoor dry type, vacuum impregnated resin insulated, naturally cooled.

All The transformers shall be of low loss and low noise level type with moisture-proof, tropicalized, flame resistant and self-extinguishing insulation. The transformer shall be free from partial discharges up to 150% of the rated voltage. The transformer shall be able to withstand all forces caused by a



worst short-circuit on the low voltage terminals without any damage. All open metal parts shall be highly protected against corrosion.

The transformer shall be equipped with necessary accessories such as temperature sensors of PTC-thermistor type including a solid-state switching device with relay output (one each for alarm and tripping) for the maximum hot-spot winding temperature installed on each leg of the winding. Auxiliary wiring for the transformers shall be run in protective conduit and terminated in a terminal box.

The transformer core shall be designed to maintain flux density well below saturation and shall be made from high permeability, grain-oriented, non-aging Silicon steel. Core shall be step-lap, cruciform construction with mitered joints. Core shall be visibly grounded to the enclosure by means of a flexible grounding conductor in accordance with applicable ANSI and other international standards.

The enclosure shall be of at least IP 31 with enclosure thickness of at least 2.5 mm. The transformer base shall be of rigid steel welded construction and shall include provisions for lifting, jacking and skidding or rolling in both directions with two tapped holes for attaching ground leads one in each diagonally opposite corner of the base. The transformers shall also be fitted with the necessary transformer rails and wheel blocking devices.

#### 22.4.2 Specific Technical Parameter

Sl. No.	Particulars	Value
1.	Type of Transformer	Dry Type
2.	No. of phase	3
3.	Installation	Indoor
4.	Rated KVA	To be Specified by Power Station
5.	Minimum % Impedance at Principal Tap, rated MVA and rated frequency	As per IEC 60076-5
6.	Type of cooling	AN
7.	Winding material	Copper
8.	Connection of Transformer	
9.	HV Winding	Delta
10.	LV Winding	Star with neutral directly earthed
11.	Vector Group	Dyn11
12.	Rated frequency	50 Hz
13.	Rated Voltage	
a)	HV Winding , kV	11 / 13.8 (To be Specified by Power Station)
b)	LV Winding , KV	11 / 0.415(To be Specified by Power Station)
14.	Tap Changer	
a)	Type	Off circuit
b)	Range	From -5% to +5%

c)	Steps	5, at 2.5% each
d)	Location	HV side
15.	Power frequency withstand voltage	
a)	H.V winding	38 KV (for 13.8 KV) / 28kV (for 11 KV)
b)	L.V. winding	28kV (for 11 KV) / 3 kV (for 415V)
16.	Rated lightning impulse withstand voltage of HV winding (peak)	75 kV
17.	Class of insulation	H
18.	Rated short circuit current on LV side	25 KA (for 13.8 / 11 KV) / 50 KA (for 11/0.415 KV)
19.	Neutral Bushing CT	If required by Power Station
a)	CT ratio	To Be Specified by Power Station
b)	No. of CTs for each transformer	To Be Specified by Power Station
c)	Accuracy	
i)	For Protection	PS
ii)	For Metering	0.2 S

## 23 OIL TYPE AUXILIARY TRANSFORMER

### 23.1 Scope of Work

The specification covers the design, manufacture, assembly, inspection and testing at the manufacture's work, packing and delivery of Auxiliary Transformer complete with cubicles and all necessary accessories such as bushings, off-circuit tap changer, CTs, instrumentation, fittings etc. at XXX Power station of NHPC Limited.

### 23.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification:

Sl. No.	Standards	Description
1.	IEC 60076	Power transformers
2.	IS 1180 Part1-2014	Outdoor type Oil Immersed Distribution Transformers up to and including 2500kVA,33 kV-Specification

### 23.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 23.4 Functional Characteristics

The Transformer shall be used as Unit Auxiliary Transformer (UAT) / Station Auxiliary Transformer (SAT) / Auxiliary Power Transformer (APT) etc.

Each Transformer shall be clearly identified with suitably located nameplate(s). Nameplates shall be furnished for all instruments, control switches, etc. Each section of an assembly shall have an identifying name plate placed near the top edge.

All secondary and control wiring shall be done with stranded copper wires, current transformer secondary leads shall not be less than 4.0 mm<sup>2</sup>. All control wiring within the assembly housing shall be installed at the manufacturer's premises. All connections shall be made with solder less lugs. All wires and connections to remote equipment shall be wired to terminal blocks.

The current transformer (if required) shall be single phase single core inductive type. It shall be mounted within the cubicles and shall comply with the requirements of relevant IEC 61869. The secondary windings of all current transformers shall be grounded at one point only and means shall be provided to facilitate the secondary windings to be short-circuited

#### 23.4.1 Constructional details

Oil filled transformer shall be of the outdoor type, ONAN cooled. The transformer shall be equipped with necessary accessories such as temperature sensors for oil & winding temperature relay output (one each for alarm and tripping). Buchholz Alarm & trip relay shall also be provided. The

transformer shall be fitted with lifting lugs or holes and provisions for jacking and rolling.

**23.4.1.1 Core:**

The cores shall be constructed from Cold Rolled Non Ageing Grain Oriented Silicon Steel Laminations. Adequate lifting lugs shall be provided to enable the core and windings to be lifted. Adequate provision shall be made to prevent movement of the core and winding relative to the tank during transport and installation or while in service.

The supporting framework of the cores shall be so designed as to avoid the presence of pockets, which would prevent complete emptying of the tank through the drain valve, or cause trapping of air during filling.

**23.4.1.2 Winding:**

The winding shall be designed to withstand the highest system voltage continuously. The insulation of transformer windings and connection shall be free from insulating composition liable to soften, ooze out, shrink or collapse and be non-catalytic and chemically inactive to transformer oil during service. The coil clamping arrangement and the finished dimensions of any oil ducts shall be such as will not impede the free circulation of oil through the ducts. The edges of copper conductor shall be smooth so as to ensure that the vibrations do not damage the paper wrapped leading to a fault.

**23.4.1.3 Bushing:**

The HV winding of transformer shall terminate on porcelain type bushings. A stress shield shall be considered as an integral part of bushing assembly. Current transformer, where required, shall be provided and the bushings shall be independently supported to ensure secure removal of bushings without disturbing the current transformer secondary terminals and connections.

**23.4.1.4 Tank:**

The transformer tank and cover shall be fabricated from good commercial grade low carbon steel. The tank and the cover shall be tank type and of bolted construction. All joints, which may have to be opened from time to time in the course of operation, shall be designed to permit their being made oil-tight during reassembly easily. The tank shall be reinforced by stiffeners of structural steel for general rigidity. The tank shall have sufficient strength to withstand, without permanent distortion, during

- i) Filling under vacuum,
- ii) Continuous internal gas pressure of 0.35 atmosphere with oil at operating level,
- iii) Short circuit forces,
- iv) Mechanical shocks during transportation in fully assembled and in oil filled condition.

At least one manhole with bolted cover shall be provided on the tank cover for inspection and connection and manhole shall be of sufficient size to afford easy access to the lower end of the bushings, core and coil.

All bolted connections to the tank shall be fitted with suitable oil tight gaskets. The tanks of all transformers shall be designed so as to allow complete transformer with all accessories and filled with oil, to be lifted by jacks and local movement in transformer area, without overstraining any joints and without causing subsequent leakage of oil.

The transformer tank shall be equipped with appropriate size of valves for oil filling, oil draining, oil sampling, oil filtering purpose. All the valves shall be

provided with standard screw connections for external piping. The opening of oil filter valve shall be baffled to prevent aeration of the oil and shall have padlock arrangement.

All bolts and nuts used in connection with the tank and fittings shall be electro-galvanized. As far as possible the transformer tank and its accessories shall be designed without pockets where gas may collect. Where pockets cannot be avoided, pipes shall be provided to vent the gas off.

**23.4.1.5 Gas and oil actuated relay (Buchholz relay)**

Each transformer shall be fitted with gas and oil actuated relay having alarm and trip contacts, which close following oil surge or low oil level conditions. Each gas and oil actuated relay shall be provided with a test cock to take flexible pipe connection for checking the operation of the relay and sampling of accumulated gases.

To allow gas to be collected at ground level, a pipe shall be connected to the gas release cock of the gas and oil actuated relay terminated by a cock. The design of the relay mounting arrangement, the associated pipe work shall be such that mal-operation of the relays shall not take place under normal service conditions.

**23.4.1.6 Conservator vessel, oil gauge and breather**

A conservator complete with drain valve shall be provided, having a capacity to meet the requirement for expansion of the total cold oil volume in the transformer and cooling equipment from the minimum ambient temperature to 105 deg. C. The Conservator shall be provided with oil level indication arrangement easily observed from a distance.

Each conservator vessel shall be fitted with breather in which silica gel is the de-hydrating agent in such a way that:

- i) The passage of air shall be such that it is first filtered through oil bath and then shall pass through silica gel.
- ii) The external atmosphere is not continuously in contact with the silica gel.
- iii) The moisture absorption indicated by a change in colour of tinted crystals can be easily observed from distance.
- iv) The breather shall be mounted at safe height above ground level.

**23.4.1.7 Pressure relief device**

The suitable pressure relief device, specifically designed for transformer protection, shall be provided for protection from internal overpressure. The no. of devices shall be worked out according to the volume of oil.

**23.4.2 Specific Technical Parameter**

Sl. No.	Particulars	Value
1.	Type of Transformer	Oil filled
2.	No. of phase	3
3.	Installation	Outdoor
4.	Rated KVA	To Be Specified by Power Station
5.	Minimum % Impedance at Principal Tap, rated MVA and rated frequency	As per IEC 60076-5
6.	Type of cooling	ONAN

7.	Winding material	Copper
8.	Connection of Transformer	
9.	HV Winding	Delta
10.	LV Winding	Star with neutral directly earthed
11.	Vector Group	Dyn11
12.	Rated frequency	50 Hz
13.	Rated Voltage	
a)	HV Winding , kV	33 / 11 (To be Specified by Power Station)
b)	LV Winding , KV	11 / 0.415 (To be Specified by Power Station)
14.	Tap Changer	
a)	Type	Off circuit
b)	Range	From -5% to +5%
c)	Steps	5, at 2.5% each
d)	Location	HV side
15.	Power frequency withstand voltage	
a)	H.V winding	70 KV (for 33 KV) / 28kV (for 11 KV)
b)	L.V. winding	28kV (for 11 KV) / 3 kV (for 415V)
16.	Rated lightning impulse withstand voltage of HV winding (peak)	170 KV (for 33 KV) / 75kV (for 11 KV)
17.	Class of insulation	A
18.	Rated short circuit current on LV side	25 KA (for 13.8 / 11 KV) / 50 KA (for 11/0.415 KV)
19.	Neutral Bushing CT	If required by Power Station
a)	CT ratio	To Be Specified by Power Station
b)	No. of CTs for each transformer	To Be Specified by Power Station
c)	Accuracy	
i)	For Protection	PS
ii)	For Metering	0.2 S

## **24 GENERAL ELECTRICAL TOOLS & INSTRUMENTS**

### **24.1 Scope of Work**

The specification covers the supply of general electrical tools & Instruments for use in various purposes at XXX Power station of NHPC Limited.

### **24.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :-
- ii) Minimum ambient temperature (Deg. C) :-
- iii) Maximum relative humidity (%) :-
- iv) Height above Sea Level (m) :-

### **24.3 Functional Characteristics:-**

Instruments shall have following minimum technical requirement:-

#### **24.3.1 Single phase toroidal transformers with:**

- i) Primary voltage: 230 V,
- ii) Secondary voltage: 0 ... 230 V step less adjustable,
- iii) Rated power: 2500 VA.

#### **24.3.2 Three phase toroidal transformers with:**

- i) Primary voltage: 400 V,
- ii) Secondary voltage: 0 ... 400 V step less adjustable,
- iii) Rated power: 1500 VA.

#### **24.3.3 Portable digital power measuring instrument**

- i) Suitable for 3 phase and single phase measurement
- ii) Power basic accuracy class 0.2, 0 to 100 kW in several steps
- iii) Current accuracy class 0.2, 0 to 100 A in several steps,
- iv) Voltage accuracy class 0.2, 0 to 500 V in several steps,
- v) Phase sequence indicator,
- vi) Power factor meter (Lead and Lag)
- vii) Necessary interface for PC communication

#### **24.3.4 Phase-sequence indicators with:**

- i) Voltage: 100...500 V,
- ii) Terminals marked with L1, L2, L3,
- iii) Protection Lead Cat – III, 600V.
- iv) Frequency 15... 400 Hz,

#### **24.3.5 Portable digital frequency meters with:**

- i) Accuracy class: 0.5,
- ii) Rated voltages: 5 V -550 V,
- iii) Ranges: 40 - 60 Hz,

#### **24.3.6 Non-contact type portable Thermometer (IR):**

- i) Accuracy:± 1.0 % reading,

- ii) Range: -40°C to +450°C in several steps,
- iii) Setting time: maximum 3 seconds,

**24.3.7 Silt measuring instruments**

- i) Instrument shall be suitable for sedimentation range of minimum 8000 mg/L and sedimentation size range of 2.5 to 500 microns.
- ii) Instrument shall be based on small angle laser scattering principle and compliant with ISO-13320-1.
- iii) The instrument enclosure shall be RFI/ EMI protected.
- iv) Feature for PC connection and analysis.

**24.3.8 Digital mechanical revolution counters with:**

- i) Range: 0.5...15000 rpm in several steps,
- ii) The instrument shall be incorporated with in-built over current and over voltage protection.

**24.3.9 Small size clamp-on volt-ammeters with:**

- i) Accuracy class: 1.5,
- ii) Ranges: 1.2...60 A and 60...600 V in several steps,
- iii) For round conductors up to 30 mm diameter,
- iv) For flat conductors up to 30 x 45 mm,
- v) All accessories

**24.3.10 Big size clamp-on volt-ammeters with:**

- i) Accuracy class: 1.5,
- ii) Ranges: 10...500 A and 240...500 V in several steps,
- iii) For round conductors up to 42 mm diameter,
- iv) For flat conductors up to 60 x 24 mm,
- v) All accessories

**24.3.11 Portable multi-channel vibration meter with:**

- i) Frequency range up to 10-1000 Hz,
- ii) Sufficient memory and computer connectivity,
- iii) Suitable for vibration measurement in acceleration, velocity and displacement mode over frequency range
- iv) Complete with all accessories including power supply, ear phone, case etc.

**24.3.12 Portable earth resistance measuring device with:**

- i) Accuracy class: 1,
- ii) Digital indication,
- iii) Measuring ranges:
  - 0...20Ω in steps of .01Ω
  - 0...200Ω in steps of 0.1 Ω
  - 0...2000Ω in steps of 1.0Ω
- iv) Measuring case completely equipped with all accessories required for a proper measurement of the protective earthing resistance according to the



relevant IEC recommendations for measuring of the earthing resistance of switchgears, lighting system, etc. and the specific soil resistance.

#### **24.3.13 Portable Micro ohm-meter**

Suitable for measuring contact resistance of high voltage equipment, with:

- i) 230 V AC power supply,
- ii) Measuring range: 0 - 1999 $\mu\Omega$ ,
- iii) Accuracy: 0.1% of reading Resolution: about 1 $\mu\Omega$
- iv) Output current: 0 - 400 A DC,

#### **24.3.14 On line DC earth fault locator with:**

- i) The online DC fault locator shall pinpoint grounding resistance faults from 1 $\Omega$  to 100K $\Omega$ ,
- ii) Equipment shall distinguish the direction of current flow, comparison of signal strength for fast fault detection,
- iii) Equipment shall be based on injection of low frequency signal.
- iv) Equipment shall be immune to electrical noise/ interferences.
- v) There shall be a display to indicate test currents of respective conductors.
- vi) Equipment shall be battery operated with internal battery charger
- vii) All necessary cables, leads, clamp on current sensor of about 10m length required for measurements.

#### **24.3.15 IR based Thermal Image camera**

Suitable for online monitoring of electrical and mechanical equipment with

- i) Rechargeable battery,
- ii) 230 V AC, charger unit
- iii) Min 100 Thermal images storage in camera
- iv) Analysis PC software and image transfer to PC facility
- v) Imaging resolution of 640 x 480 or better. Thermal sensitivity of approx. 40 mK @30 deg C
- vi) Temperature range from -30 to 650 deg C
- vii) Accuracy +/- 2 deg C or 2% of reading.
- viii) Focal distance of approx. 0.25 m.
- ix) Focal point array: Uncooled microbolometer type 640 x 480 pixels,
- x) The camera shall show the min and max temperature of image. Camera shall be light weight and supplied with carrying case and rechargeable battery from single phase supply

#### **24.4 Standard Features**

- i) The instruments shall have Safety rating of CAT IV 600V at Maximum altitude of XXXX m (To be specified)
- ii) The instruments shall be supplied with calibration certificate issued from Govt. approved laboratory.
- iii) The instruments shall be supplied with measuring test leads.
- iv) The instruments supplied shall have minimum period of one year warranty.

## **25 CATHODE RAY OSCILLOSCOPE**

### **25.1 Scope of Work**

The specification covers the supply of digital portable dual beam storage type cathode ray oscilloscope for use in various purposes at XXX Power station of NHPC Limited.

### **25.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **25.3 Functional Characteristics:-**

- 1) The digital portable dual beam storage type cathode ray oscilloscope for chopped and alternative operation mode shall have following minimum technical requirement:
  - i) Mode of operation channel A / channel B / channels A+B / channels A-B, Two (2) independent y-channel amplifiers,
  - ii) Bandwidth 500MHz
  - iii) Max. sampling rate 2 GSa/s [per channel]
  - iv) Max. record length 2.5 M words [per channel]
  - v) Vertical Sensitivity 5 mV...20 V [per division]
  - vi) Vertical Resolution 8 bits
  - vii) Time base 2.5 ns...50 s [per division]
  - viii) Time base accuracy 50ppm ( $\pm 0.005\%$ )
  - ix) Horizontal zoom
  - x) Internal and external triggering
  - xi) Input voltage: max. 240V (peak to peak)
  - xii) Display: 8.4" colour TFT LCD
  - xiii) Connection voltage: 230 V, 50 Hz
  - xiv) Storage PC card, Flash ROM, USB I/F
  - xv) Interfaces USB, RS-232
  - xvi) Operating Temperature 0 °C to +50 °C.
  - xvii) Storage temperature -40 °C to +71 °C.
  - xviii) Operating Humidity up to 60%RH up to 50 °C.
  - xix) Storage Humidity up to 60%RH up to 55 °C.
  - xx) All accessories and connection facilities

### **25.4 Standard Features**

- i) The instruments shall have Safety rating of CAT IV 600V at Maximum altitude of XXXX m (To be specified)
- ii) The instruments shall be supplied with calibration certificate issued from Govt. approved laboratory.

- iii) The instruments shall be supplied with measuring test leads.
- iv) The instruments supplied shall have minimum period of one year warranty.

**26 CIRCUIT BREAKER OPERATION ANALYSER (WITH DCRM KIT)**

**26.1 Scope of Work**

The specification covers the supply of Circuit breaker operation analyser (along with DCRM kit) for use at XXX Power station of NHPC Limited.

**26.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

**26.3 Functional Characteristics:-**

The instrument shall be used for Testing of circuit breakers in live / charged switchyard (up to 145 KV / 245 KV / 420 KV AC – To be specified). It shall be suitable to perform close, open, close-open, open-close-open operations on CB under test (with a facility to introduce time delay between composite operations) and to measure and record breaker closing & opening timings during aforesaid operations (of main contact and pre-insertion time for PIR contacts).

The operation analyser shall be suitable to measure and record contact speed, travel of contact and contact wipe at various stages of operations. It shall have the facility to measure Dynamic contact resistance of arcing contact and main contact while closing/opening of C.B. It shall be suitable to measure auxiliary contact (wet and dry) timings.

The operation analyser shall be suitable to measure and record current rise & all of tripping and closing coils. It shall have availability of minimum no. of following channels:

- i) Twelve (12) time measuring channels, expandable to further eight (08) similar channels
- ii) Six (06) analog channels for trip/close coil currents and for contact travel measurement.
- iii) Auxiliary contact timing channels (02 dry & 02 wet)

The instrument shall contain all standard accessories including testing lead of 20 meter length with suitable clamp/connectors and carrying case. Required software for analysis of data measured shall be supplied with the test kit. The testing equipment shall be robust in design so that it can be transported from one place to other and performance shall not be affected even in worst conditions. Test kit shall be suitable for simultaneous measurement of DCR for both breaks of one pole of C.B, if existing.

The instrument shall have menu driven software to enable the user its easy operation. It shall be possible to enter various test parameters and relevant data such as date, breaker no. etc. in the analyser (which will appear as header for each print). The analyser shall have facility to download test results to a PC. A portable memory bank shall be provided to store the results, taken by kit at site.

The test kit shall be suitable for 240 volts  $\pm$  10% and 50 Hz  $\pm$  5%, single phase AC input supply.

**27 AUTOMATIC CAPACITANCE AND TANδ KIT**

**27.1 Scope of Work**

The specification covers the supply of Automatic Capacitance & Tanδ kit for use at XXX Power station of NHPC Limited.

**27.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

**27.3 Functional Characteristics:-**

Instrument shall have following minimum standard features:

- The kit shall be suitable for measurement of capacitance and Tanδ of EHV class transformers / shunt reactors / Current transformers / CVT and grading capacitors of Circuit Breakers at site automatically in a charged switchyard up to 145 KV / 245 KV / 420kV AC.
- The instrument shall contain all standard accessories including testing lead of 15 meter length with suitable clamp/connectors and carrying case.
- The kit shall be capable of measuring capacitance and tan delta of each winding of the transformers in suitable mode so that capacitance of other windings does not affect the reading.
- Kit shall be able to measure capacitance and tan delta/power factor automatically without balancing any decade and also interference suppression shall be automatic.
- The kit shall be complete with measuring bridge, HV power supply unit of 10kV, standard capacitor etc.
- The effect of induced voltage on instrument during testing for getting null point should be fully compensated.
- The kit shall be capable of measuring excitation current of transformer winding at 10kV.
- The instrument should have been proven for repeatability of test results in charged switchyard conditions.
- The kit shall be capable of operating and storing data at temperature from 10°C to 50°C and humidity up to 90%.
- Input supply of the kit shall be A.C 230 Volts 50 Hz, Variations ±15% and 5% on voltage and frequency.
- Technical requirements

Output Voltage	0 to 10kV in continuously adjustable range
Tan Delta Measurement range	0-200% with an Accuracy of ±1%, Resolution ± 1x10 <sup>-4</sup> .
Capacitance Measurement range	1.0 pF to 50000 pF with an Accuracy of ±1%, Resolution ±1pF.

## **28 PRIMARY CURRENT INJECTION SET**

### **28.1 Scope of Work**

The specification covers the supply of Primary Current Injection set for use at XXX Power station of NHPC Limited.

### **28.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **28.3 Functional Characteristics:-**

The equipment shall have following minimum technical requirements:

- i) The equipment shall be trolley mounted and shall consist of double wound transformer having primary winding rated for 230 V, 60kVA and twenty secondary windings each rated for 500 A, 5 V.
- ii) Current range of 500A, 1000A, 2000A, 3000A, 4000A, 5000A and 10000A shall be obtainable by connecting secondary windings in series, parallel and in series parallel.
- iii) Equipment shall have a controller to vary current and voltage output automatically. All the secondary windings shall be brought out which shall be selectable by means of links.
- iv) Equipment shall be of continuous duty cycle having accuracy of  $\pm 1\%$
- v) Equipment shall have In built memory and port for PC communication
- vi) Oil cooled type continuous rated Auto Transformer of 60 KVA rating for obtaining stepless variation on output shall be provided.
- vii) Unit shall be supplied with first filling of oil plus 10% extra oil and output connecting cable suitable for 10000 Amps and of 15m length.
- viii) The cable shall have two cores and shall be provided with suitable clamps at both the end of the cable for testing of any outdoor EHV equipment.
- ix) The unit shall have multi ratio current transformer and ammeter for measuring current output.
- x) The instrument shall comply with relevant IEC, safety and EMI/EMC standards.

**29 HV-AC TEST SET**

**29.1 Scope of Work**

The specification covers the supply of HV-AC test kit for use at XXX Power station of NHPC Limited.

**29.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

**29.3 Functional Characteristics:-**

- i) Testing kit (for testing of XXX MW machines) shall be used for testing the dielectric strength of electrical insulation of generator stator winding as well as of different cables.
- ii) The kit shall have following minimum technical parameter:
  - Input 230-V AC, 50-Hz
  - Output 40KV, 10 Amp (Minimum)
  - Accuracy  $\pm 2\%$ ,
  - Leakage Current:  $\pm 5\%$
- iii) Test voltage shall be continuously adjustable from zero to full output, with a zero-start interlock.
- iv) A front-panel knob may adjust leakage current trip level with digital electronic test timer.
- v) Pushbuttons shall be provided to select one-second or continuous testing, to turn off the high voltage and to reset the instrument.
- vi) All high-voltage connections shall be recessed to prevent accidental contact with high voltage.
- vii) During testing, isolation of high voltage shall take place automatically within 50 ms of arcing or tripping on exceeding the preset trip level.
- viii) Visual and audible alarms to alert the operator upon failure shall be provided.
- ix) Interlock to prevent the high voltage from being applied if the supply ground wire is open or if the hot and neutral wires are interchanged.
- x) A Tester Grounded lamp lights to confirm the instrument is connected to a properly grounded power source.
- xi) Output signals for both voltage and current meters, on all ranges, to permit external recording of test data.
- xii) The instrument should comply with relevant IEC, safety and EMI/EMC standards.

**30 TRANSFORMER DC WINDING RESISTANCE MEASUREMENT KIT**

**30.1 Scope of Work**

The specification covers the supply of portable Transformer DC Winding Resistance Measurement Kit for use at XXX Power station of NHPC Limited.

**30.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

**30.3 Functional Characteristics:-**

- i) The instrument shall be used for measuring DC winding resistance of the transformer / reactor where large inductance is present.
- ii) The test kit shall be able to withstand inductive kicks from transformer winding. Variation in test current shall not result in loss of accuracy.
- iii) The display or resistance should be through direct LED/LCD without requiring any balancing of decades to obtain stable readings.
- iv) It should employ four-point method and no lead compensation shall be required for measurement.
- v) Built-in discharge circuit shall be provided to discharge the specimen when test is completed when current lead accidentally disconnects or when instrument power supply is lost.
- vi) Input supply of the kit shall be 240Volts AC, 50 Hz.
- vii) Technical Parameters
  - Test current 25 Amp
  - Resolution 1 milli-Ohm
  - Range upto 100 ohms
  - Accuracy  $\pm 0.5\%$  of full scale reading or better
  - Open circuit voltage min. 30 Volts, DC
- viii) The instrument should comply with relevant IEC, safety and EMI/EMC standards.



## **31 UNIVERSAL RELAY TESTING KIT**

### **31.1 Scope of Work**

The specification covers the supply of portable microprocessor based universal relay testing kit along with licenced software for use at XXX Power station of NHPC Limited.

### **31.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **31.3 Functional Characteristics:-**

#### **31.3.1 Standard Feature**

- i) The three phase, Portable microprocessor based universal relay testing kit shall be fully automatic using software and shall be suitable for testing all generations and all types of protection relays, from high burden electromechanical to IEC 61850 complied Numerical relays.
- ii) The testing kit shall be suitable for Stand-alone operation using built-in intuitive high-resolution graphic touchscreen and no PC shall be required to operate it.
- iii) The testing kit shall have facility to save the Tests & test results in built-in memory, and also to download / transfer of test data to PC through USB drive / port.
- iv) Suitable software shall also be provided / install for full automatic testing through a PC with Windows 10 or latest operating system
- v) The testing kit shall have minimum three Ethernet ports, two USB type A port, One USB Type B Port and a Bluetooth wireless interface as built-in standard features.
- vi) All outputs shall be protected against over-temperature, accidental short-circuits, external high-voltage transient signals and monitored in case of overload.
- vii) The testing kit shall have minimum 6 current and 4 Voltage channels
- viii) Each current channel shall be rated for minimum 32 A at 200 VA continuous.
- ix) The testing kit shall complete with following minimum accessories
  - Indian standard Power cord (min 1 X 2 m length)
  - Ethernet cables (1 X 1.5 m length)
  - Ethernet Cable (1 X 3 m length)
  - USB connecting cable (1 X 2 m length)
  - Leads with 4 mm safety plugs (6 x red, 6 x black, each of 2 m length)
  - Flexible terminal adapters (12 x black)
  - Flexible test lead adapters with retractable sleeve (6 x red, 6 x black)
  - Grounding cable with battery clamp and M6 cable lug 6 m

- Sturdy transport case with hard-foam interior, wheels, and extendable handle, Watertight, airtight, dustproof, chemical resistant and corrosion proof
  - Soft padded side carry case for Kit
  - Accessories carry case to carry power cord, Ethernet cable, and test leads
  - Instruction Manual
- x) The testing kit shall measure and display AC voltage, AC current, DC Voltage, DC Current, Frequency, impedance, power, power factor, phase angle and time via an easy to read liquid crystal display.
- xi) A hold function shall be provided which will allow voltage and current readings to be taken for the duration of half a cycle or less. The timer start-stop input shall respond to change a voltage for contact opening and closing.
- xii) Indication shall be provided to show status of timer start-stop inputs with normally opened (NO) and normally closed (NC) contacts of relays.
- xiii) Provision for continuous phase shifting and fine adjustment of voltage and current shall be incorporated in the testing kit.
- xiv) The testing kit should comply with relevant IEC, safety and EMI / EMC standards.

## **32 INSULATING OIL FILTRATION PLANT**

### **32.1 Scope**

The specification covers the design, manufacture, supply and delivery of Insulating Oil Filtration plant for use at XXX Power station of NHPC Limited.

### **32.2 Standards and Regulations:**

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IS 6034	Insulating oil conditioning plants - specification

### **32.3 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **32.4 Functional Characteristics**

The system shall comprise of 6000 LPH (To be specified) mobile skid mounted insulating oil purifying plants complete with transformer evacuation system, oil hoses, vacuum hoses, hose couplings and other accessories to complete the system,

The insulating oil purifiers shall be of filtration and vacuum de-hydration type.

Unit shall consist of coarse filter, oil transfer pump, thermostatically controlled ceramic heaters, filtration section, deoxidizing column, vacuum pumps, discharge pump, two stage degassing system, transformer evacuation system, thermometers, pressure / vacuum gauges, flow meter, valves, piping, control panels with on-line process monitoring facilities and other accessories necessary for satisfactory operation of purifiers.

The insulating oil purifiers shall be suitable for indoor and outdoor duties.

The manufacturer shall select the operating temperature and size of the oil heater to heat the oil from normal room temperature to the design operating temperature. The heaters used shall be ceramic type sealed heaters.

Vacuum gauges to monitor vacuum shall be provided at various stages in the transformer evacuation system and in the external pipe beyond the isolation valve for external system

The oil hoses for each plant shall be of sufficient length (minimum 125m) and size to filter the oil of any transformer unit by placing the filtration plant at one end of the transformer cavern. The vacuum hoses shall also be of sufficient size & length for evacuation of the Transformers

### **32.4.1 Insulating oil handling system**

The purifier shall be capable of processing the oil on single pass basis at rated flow to the following specification:

- |      |                                   |                         |
|------|-----------------------------------|-------------------------|
| i)   | Moisture content :                | Less than 5 PPM         |
| ii)  | Gas content :                     | Less than 0.1%by volume |
| iii) | Dielectric strength:              | 70 kV across 2.5 mm gap |
| iv)  | Filtration :                      | Less than 1 micron      |
| v)   | Power factor Tan Delta at 90 °C : | 0.002                   |

### **32.4.2 Transformer evacuation system**

- i) Capacity to have an ultimate blank-off of 10-4 Torr or less,
- ii) Evacuation to the level of 0.1 Torr or less when connected to main transformer tank.

### **32.5 Installation & Commissioning of Insulating oil Filtration Plant**

- Supervision for Installation.
- Supervision for Commissioning, calibration & testing of Insulating oil Filtration Plant is covered under scope of supply
- Preparation and submission of test report on Insulating Oil Filtration plant
- Training at site for customer's engineers.

### **32.6 Drawing & Manual:**

The bidder shall submit following information:-

- Manufacturer's leaflets giving construction details, schematic diagram, dimensions and characteristics of the system
- Field installation/commissioning manual.
- O & M Manual.

### **33 TURBINE OIL FILTRATION PLANT**

#### **33.1 Scope**

The specification covers the design, manufacture, supply and delivery of Turbine Oil Filtration Plant for use at XXX Power station of NHPC Limited.

#### **33.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

#### **33.3 Functional Characteristics**

The system shall comprise of 1200 LPH (To be specified) mobile skid mounted centrifuge type lubrication oil purifying plants complete with oil hoses, hose couplings and other accessories to complete the system.

The purifying unit shall be a complete self-contained and enclosed unit with motor-driven pumps or pump of suitable rating, centrifuging chamber and other appurtenances such as valves, magnetic strainer, gear pump, dial thermometer, oil heater, safety thermostat, safety relief valve, filters, degassing chamber, float switch, discharge pump, oil sampling valve, rotary vacuum pump, control cabinet, NRV e.t.c. to make the system complete and functional.

The lubricating oil may contain free and dissolved moisture of the order of 1000 to 2000 PPM initially which needs to be reduced in the range of 50 PPM, Besides moisture, the oil may contain suspended impurities such as cotton waste, welding slag and spatters, metallic chips, small sand particles, iron fillings, pebbles, dust and pipe scales. The offered equipment shall not be damaged by the flow of oil containing these impurities. The oil may also contain grease and kerosene, which shall also be required to be removed. The purifier shall reduce the free and dissolved moisture in the lubricating oil to acceptable level for re-use.

The purifier shall be capable of processing the lubricating oil on not more than two (2) passes basis at rated flow to the following specification:

i)	Free water:	100% reduction
ii)	Moisture content:	Less than 50 PPM
iii)	Filtration:	Less than 1 micron

#### **33.4 Installation & Commissioning Of Turbine Filtration Plant Equipment**

- Supervision for Installation.
- Supervision for Commissioning, calibration & testing of Turbine oil Filtration plant is covered under scope of supply
- Preparation and submission of test report on Turbine oil Filtration plant
- Training at site for customer's engineers.

**33.5 Drawing & Manual:**

The bidder shall submit following information:-

- Manufacturer's leaflets giving construction details, schematic diagram, dimensions and characteristics of the system
- Field installation/commissioning manual.
- O & M Manual.

### **34 ONLINE ULTRASONIC FLOW MEASUREMENT SYSTEM**

#### **34.1 Scope**

The specification covers the design, manufacture, supply and installation of Online Ultrasonic Flow Measurement System comprising of Eight (8) Path Ultrasonic Flow meter along with associated accessories for interfacing of each flow meter with SCADA Control System for use at XXX Power station of NHPC Limited.

#### **34.2 Standards and Regulations:**

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IEC 60041	Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines

#### **34.3 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m)

#### **34.4 Functional Characteristics**

The flowmeter system supplied shall include all interconnecting wiring required to measure the flow rate and net head for display and printing the measured values. The interconnecting cables between transducer and flow measurement system shall be shielded to keep transducer signal free from undesirable noise of the Power House. The flow meter shall measure flow velocity and totalize volume flow to a shop guaranteed accuracy of  $\pm 0.5\%$  or better without on-site calibration of each unit. The sampling rate shall be at least (4) flow rates per second. The design pressure of the transducer shall be suitable to withstand maximum pressure surges that occur in the water conductor system. The transducers shall be capable of being installed or taken off from the unit without the necessity of dewatering the penstock. The reinstallation of transducers shall not require recalibration of the flow meter. The transducers shall not obstruct fluid flow significantly or create energy losses. The transducer housing shall be of stainless steel and shall be provided with stainless steel isolating valve to allow maintenance of transducer with units running.

#### **34.5 Installation & Commissioning of the Ultrasonic Flow Measurement Equipment**

- Supervision for Installation.
- Supervision for Commissioning, calibration & testing of complete set of Ultrasonic flow Measurement equipment covered under scope of supply for each Unit.

- Preparation and submission of test report on ultrasonic Flow Measurement equipment for each Unit.
- Training at site for customer's Engineers.

**34.6 Drawing & Manual:**

The bidder shall submit following information:-

- Manufacturer's leaflets giving construction details, dimensions and characteristics of the system.
- Field installation/commissioning manual.
- O & M Manual.



## **35 GAS FILLING AND EVACUATION PLANT FOR GIS**

### **35.1 Scope**

The specification covers the design, manufacture, supply and delivery of Gas Filling and Evacuation plant for GIS for use at XXX Power station of NHPC Limited.

### **35.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **35.3 Functional Characteristics**

- 1) Gas processing & filling units, along with tools for gas handling to handle gas quantity in at least two largest gas sections, with provision to check SF6 moisture and acidity content complete in all respect including but not limited to following:
  - i) Gas processing and control unit
  - ii) SF6 filling trolley
  - iii) Distribution set (connectors and pipes as required)
  - iv) Hygrometer
  - v) SF6 gas % measuring device
  - vi) Acidity controller
  - vii) Pipes with connectors
  - viii) Manometer fitted with pressure reducer and accessories
  - ix) Filling handle for SF6 filling
  - x) Vacuum pump with maintenance kit

### **35.4 Installation & Commissioning Of GAS FILLING AND EVACUATION PLANT FOR GIS Equipment**

- i) Supervision for Installation.
- ii) Supervision for Commissioning, calibration & testing of Gas Filling and Evacuation plant covered under scope of supply
- iii) Preparation and submission of test report on Gas Filling and Evacuation System.
- iv) Training at site for customer's engineers.

### **35.5 Drawing & Manual:**

The bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, schematic diagram, dimensions and characteristics of the system
- ii) Field installation/commissioning manual.
- iii) O & M Manual.

## 36 SINGLE PHASE INVERTER

### 36.1 Scope

The specification covers the design, manufacture, supply and delivery of Single Phase Inverter for use at XXX Power station of NHPC Limited.

### 36.2 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 36.3 Functional Characteristics

Static inverters of on-line type shall be connected to the 220V DC system and a distribution board. Normally inverters will use 220 DC source as main source and AC supply shall be used as bypass source. The Bypass source shall be provided with static voltage stabilizer.

The inverter cubicles shall be provided with a protection class of at least IP42.

The inverter panel shall include:

- i) Electronic switches / accessories for uninterrupted power supply
- ii) Instruments for Input/output voltage, current and frequency
- iii) Alarms on the panel front

#### 36.3.2 Specific Technical Parameter

Sl. No.	Parameter	Value
1.	No. of Inverters	To be Specified by Power Station
2.	Rated capacity of each inverter	XX kVA at $\cos \phi = 0.8$ lag. (To be Specified by Power Station)
3.	Rated input voltage (dc)	220 plus ( $\pm$ ) 10%
4.	Rated output voltage (ac)	230 V, Single phase
5.	Voltage regulation	$\pm 2$ %
6.	Frequency	$50 \pm 0.5$ % Hz
7.	Wave form	Pure Sine Wave, with max. 5 % THD at linear load & max. 7 % THD at 100% non-linear load
8.	Overload capacity for 100 ms	2 times rated current
9.	Overload capacity for 1 min	1.5 times rated current

**36.4 Drawing & Manual:**

The bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, schematic diagram, dimensions and characteristics of the system
- ii) Field installation / commissioning manual.
- iii) O & M Manual.

### 37 SINGLE PHASE UPS

#### 37.1 Scope

The specification covers the design, manufacture, supply and delivery of Single Phase UPS for use at XXX Power station of NHPC Limited.

#### 37.2 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

#### 37.3 Functional Characteristics

UPS of on-line type along with distribution board and shall be suitable to feed the essential loads continuously. The UPS will be charged through respective 415 V AC distribution board.

Each UPS system shall include:

- In-built battery having back-up capacity of two (2) hour
- In-built solid state float cum boost charger with automatic boost / trickle charge modes with current limiting features
- Multifunction LED indication / LCD display system for UPS status, battery level, load level, line on, inverter on, by-pass, input & output voltage, input & output frequency, load % , battery % etc.
- Audible alarm system for AC failure, Battery Low, UPS fault etc.
- Electronic protection for output overload, short circuit, over temperature, Low battery, over charging, surge protection

#### 37.3.2 Specific Technical Parameter

Sl. No.	Parameter	Value
1.	No. of Inverters	To be Specified by Power Station
2.	Rated capacity of each inverter	XX kVA at $\cos \phi = 0.8$ lag. (To be Specified by Power Station)
3.	Rated input voltage	170 V AC to 270V AC, single phase
4.	Rated output voltage	230 V AC, Single phase
5.	Voltage regulation	$\pm 1$ %
6.	Frequency	$50 \pm 0.5$ % Hz
7.	Wave form	Pure Sine wave, with max. 5 % THD at linear load & max. 7 % THD at 100% non-linear load
8.	Overload capacity	125% for 25 sec
9.	Termination	Single phase, two wire with earth

#### 37.4 Drawing & Manual:

The bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, schematic diagram, dimensions and characteristics of the system
- ii) Field installation / commissioning manual.
- iii) O & M Manual.



## **38 CHARTLESS TYPE TEMPERATURE SCANNER**

### **38.1 Scope**

The specification covers the design, manufacture, supply and installation of chartless type temperature indicator for use at XXX Power station of NHPC Limited.

### **38.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |
|------|--------------------------------------|----|
| i)   | Maximum ambient temperature (Deg. C) | :- |
| ii)  | Minimum ambient temperature (Deg. C) | :- |
| iii) | Maximum relative humidity (%)        | :- |
| iv)  | Height above Sea Level (m)           | :- |

### **38.3 Functional Characteristics**

#### **38.3.1 Constructional Features**

The Chartless scanner cum recorder shall have following minimum features:-

- Industrial type suitable for use in hydro power plant to record / trend  
Multi range input of Universal type that allows the measurement input for DC voltage, standard signal, thermocouple (TC), resistance temperature detector (RTD), DI (voltage, contact), and DC current (by adding an external shunt resistor)
- Flush Panel Mounted type suitable for Power supply voltage of 230V AC ( $\pm 10\%$ ) / 50 Hz
- Minimum 6" LCD Colour Graphic Display with Touchscreen Control
- Operation via touch screen, using a navigator in combination with push buttons as well as using an external keyboard (USB).
- Minimum 4 Alarms (High, Low, and Rate of Change) per Channel
- Equipped with various display functions such as trend display (Horizontal as well as vertical), bar graph display, Analog meter display, Digital display, Totalised data display, Historical trend display, event summary display etc.
- Measurement data can be recorded & stored for long term (Minimum 3 Year) on internal non-volatile memory backed up by a built-in battery
- Facility to show the used memory and also to energise the alarm output in case the amount of recorded data exceeds the 90% capacity of memory card and also when the battery for backup of clock and SRAM becomes low.
- Dedicated Window (2010 or Latest) based software for Direct Data Transfer, Simultaneous Multi-File Viewing, Remote Data Acquisition & Recorder Configuration, Search, Combine, Analyse, Print and Export Data Files to Other Programs for various analysis.
- Past data saved to Compact Flash can be viewed on personal computer. Parameters for the recorder can be easily set and changed from personal computer

- Math function include Addition, Subtraction, Multiplication, Division, Totalization, Absolute value, Powers, Logarithm, Natural logarithm, Exponential function, Average value, Maximum value, Minimum value, Timers and Custom Equations etc.
- Support Integrated Web-server, Fieldbus (Modbus), standard protocols and interfaces such as USB, TCP/IP, OPC, Ethernet

### 38.3.2 Specific Technical Parameter

1	Mounting dimension	Panel cut out details to be provided by Power Station
2	Operating temperature	0 to 50°C
3	Minimum No. of inputs	To be provided by Power Station
4	Measuring Cycle	100 ms
5	Degree of Protection	IP65
6	Minimum Internal Memory	256 MB

### 38.4 Installation and commissioning of Temperature scanner instrument

Installation & Commissioning of the Ultrasonic Flow Measurement Equipment

- Supervision for Installation.
- Supervision for Commissioning, calibration & testing of complete set of Ultrasonic flow Measurement equipment covered under scope of supply for each Unit.
- Training at site for customer's Engineers.

### 38.5 Drawing & Manual:

The bidder shall submit following information:-

- Manufacturer's leaflets giving construction details, dimensions and characteristics of the system.
- Field installation/commissioning manual.
- O & M Manual.



## **39 DIGITAL ROTOR TEMPERATURE INDICATOR**

### **39.1 Scope**

The specification covers the design, manufacture, supply and delivery of Digital Rotor Temperature Indicator for use in online monitoring of field winding temperature of hydro generator at XXX Power station of NHPC Limited.

### **39.2 Climatic Conditions:**

- The climatic conditions at site under which the material shall operate satisfactory are as follows
- Maximum ambient temperature (Deg. C):- -----
- Minimum ambient temperature (Deg. C) :- -----
- Maximum relative humidity (%) :- -----
- Height above Sea Level (m) :- -----

### **39.3 Functional Characteristics**

#### **39.3.1 Constructional Features**

- The Instruments shall be flush mounting type to be mounted in Panel cut-out.
- Instrument shall have Separate Input signal for Current (from DC Shunt) and Voltage (Direct from slip rings isolated from ground)
- Digital display with readout in Degree Celsius
- Accuracy shall be  $\pm 1\%$  throughout the range under test conditions
- Resolution: 1 Degree C
- Signal Output: Output signal of 4 to 20 mA shall be provided as input to SCADA / DAS system OR communication port on RS 232 / RS 485 or Ethernet port @ 10 / 100 MBPS
- The temperature indicator shall be suitable for 85 to 270 Volts, 50 Hz.  $\pm 5\%$ , single phase, AC supply with built in SMPS (If required).
- Minimum Two nos. electrically separate, independently adjustable throughout the range.
- Alarm Contacts Rating of 250V DC, 50 Watts resistive (continuous.)
- Each alarm contact should have separate adjustable time delay of 0 to 300 seconds
- Site adjustment: Provision shall be made in RTI for zero adjustment and rotor resistance adjustment at site.
- During starting, stopping as well as during mechanical run (without excitation) RTI contacts shall not cause false tripping.
- DC –to-DC isolation transducers for voltage & current signals shall be provided as a standard feature.
- RTI shall show “O” (Zero) or “Room Temp.” when either voltage or current or both the signals are absent.

- The indicator shall be suitable for measuring the temperature of Rotor winding, the particulars of which are given in the enclosed data sheet(Annexure-1)
- The indicator shall be suitable for dual polarity of voltage and current input signals i.e. normal polarity and reversed polarity.
- The instrument shall be protected from the rotor voltage surges likely to be experienced during opening and closing of field breaker or due to short circuit across windings. It shall also be protected from stray electric and magnetic fields in the vicinity of generator

**39.3.2 Specific Technical Parameter**

1	Type	Flush Panel Type
2	Mounting Details	To be provided by Power Station
3	Rating of Generator	To be provided by Power Station
4	Rotor Winding Resistance	To be provided by Power Station
5	At 20 Degree C	XX Ohm
6	At 150 Degree C	XX Ohm
7	Field Current / Voltage	To be provided by Power Station
8	At Max. Continuous Rating	XX Amp / XX Volts
9	Short Time (for 10 seconds under ceiling conditions)	XX Amp / XX Volts
10	Max. under fault conditions on stator (for 3 seconds)	XX Amp / XX Volts
11	Shunt Rating & Accuracy	XX Amp / XX mV with 0.2% accuracy
12	Temperature Range	0 to 150 Deg. C

**39.4 Installation & Commissioning of Digital Rotor Temperature Indicator**

- Supervision for Installation, Testing, Commissioning and Calibration.
- Preparation and submission of test report.
- Training at site for customer's engineers.

**39.5 Drawing & Manual:**

The bidder shall submit following information:-

- Manufacturer's leaflets giving construction details, schematic diagram, dimensions and characteristics of the system
- Field installation / commissioning manual.
- O & M Manual.

## 40 GENERAL PROVISION OF ILLUMINATION SYSTEM

### 40.1 Scope of Work

The specification covers the supply of Lighting fittings / fixtures for use at XXX Power station of NHPC Limited.

### 40.2 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 40.3 Functional Characteristics:-

Lighting fittings / fixtures shall be designed / selected in consideration of following

#### 40.3.1 Scheme of luminaries and fittings

The luminaries selected for various indoor & outdoor locations shall be Energy efficient LED luminaries and shall comply with the following:-

- Control room, conference room and other areas wherein false ceiling is envisaged shall have Decorative type LED luminaries suitable for false ceiling
- MIV floor, Runner removal area, turbine pit, Drainage & dewatering sumps, pump area, Generator barrel (inside), draft tube gate area shall have water proof LED luminaries
- DG room shall have Explosion proof LED luminaries
- Battery room shall have Vapour and Acid fume proof luminaries.
- All other area shall have LED luminaries as per requirement

#### 40.3.2 Lux levels and quality of direct glare limitation

The nominal illumination level for lighting (ACN), measured at the height of a worktable (0.9 m), shall have an average lux value as mentioned below:

Sl. No.	Nature of area or activity	Average Lux levels	Quality class of direct glare limitation
<b>A.</b>	<b>General indoor areas:</b>		
1.	Store	300 Lux	2
2.	Changing rooms, washrooms, toilets, staircases	200 Lux	2
3.	Galleries /walkways	100 Lux	2
<b>B.</b>	<b>Office areas:</b>		
1	Control Room	500 lux	1

<b>Sl. No.</b>	<b>Nature of area or activity</b>	<b>Average Lux levels</b>	<b>Quality class of direct glare limitation</b>
2.	Offices & Conference room	400 Lux	1
3.	Other office areas	300 Lux	1
<b>C.</b>	<b>Equipment areas:</b>		
1.	Power house machine hall, service bay area, transformer area, GIB area, GIS room, electrical workshop, mechanical workshop, DG room, Relay and telecommunication room	300 Lux	2
2.	Generator barrel, Turbine pit, MV / LV panel room & other floor / areas of power house & control block	200 Lux	2
<b>D</b>	<b>Outdoor areas:</b>		
1.	Pothead yard area	150 Lux	-
2.	Entrance, exit, surge shaft and other areas	100 Lux	-
3.	Road and traffic areas	20 Lux	-

## **41 MAIN LIGHTING DISTRIBUTION BOARD**

### **41.1 Scope of Work**

The specification covers the supply of Main lighting distribution board (MLDB) for use at XXX Power station of NHPC Limited.

### **41.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **41.3 Functional Characteristics:-**

#### **41.3.1 Constructional Features**

Main Lighting Distribution Board (MLDB) shall have the following minimum constructional features:

- i) It shall have necessary dry type, natural air-cooled, non-encapsulated 3-phase, 433 V / 433 V, Y-Y connected, Class F insulated winding, lighting transformers.
- ii) It shall be a floor mounted, double front fixed type cubicle complete with bus bar system including N-Bus bar, MCCBs module, instrument transformers, Ampere meters with selector switch, Voltmeters with selector switch, Energy meters with 4-20 mA signal for SCADA, protection system, cabling, wiring and other accessories.
- iii) The load bearing member & Gland plate of panel shall be constructed with CRCA steel of minimum thickness 3 mm and other member of panel with CRCA steel of minimum thickness 2 mm
- iv) It shall have sectionalised bus section with bus coupler to support normal / emergency illumination system. Each section shall have independent incoming source with suitable interlocking.
- v) The board shall be provided with terminal blocks for incoming / outgoing circuits, earthing terminals, mounting brackets, circuit directory plate & circuit diagram fitted on the inside door etc.
- vi) The panel / board shall be fitted with close fitting, hinged, lift-off doors capable of being opened through minimum 120 deg.
- vii) The doors shall be provided with door handles with integral lock and master key.
- viii) The doors shall have PU seal for perfect sealing and longer life and shall be vermin proof
- ix) It shall be Powder coated / painted both inside & outside with minimum thickness of 90 micron.
- x) Removable gland plate shall be provided for entry of cables / conduits and located suitably to provide adequate working clearance for the termination of cables.
- xi) Each feeder shall have ON, OFF and trip LED indications in addition to inbuilt indication of ACB / MCCB
- xii) The board / panels shall be adequately ventilated, by vents or louvers

- xiii) It shall be provided with Space heating elements with thermostatic control, suitable LED lamp for panel illumination, 5/15 A power socket.
- xiv) The panel shall be provided with nameplates, identifying the purpose of the panel and all of its components.

**41.3.2 Specific Technical Parameter**

1	Incoming / outgoing supply system	Three-phase, four wire, 415V, 50Hz
2	Current rating of main bus bar	To be provided by Power Station
3	Current rating of emergency bus bar	To be provided by Power Station
4	Number and Current rating of Outgoing Feeder	To be provided by Power Station
5	Capacity of Lighting Transformer	
i)	For Normal system	To be provided by Power Station
ii)	For Emergency system	To be provided by Power Station
6	Type of Panel mounting	Floor Mounting (Mounting / Cut-out details to be provided by Power Station)
7	Minimum IP Class	
i)	Panel	IP-54
ii)	Transformer Chamber	IP-42
8	Colour Shade of Panel	To be provided by Power Station
9	Cable Entry	Bottom
10	Material of Bus bar	Copper
11	Size of Bus Bar	Size / Current requirement to be provided by Power Station
12	Panel Cables	
i)	For CT Wiring	PVC Insulated 2.5 sq. mm CU (Grey)
ii)	For Control Wiring	PVC Insulated 1.5 sq. mm CU (Grey)
iii)	For Earth Wire	PVC Insulated 2.5 sq. mm CU (Green)

## **42 HIGH MAST LIGHTING SYSTEM**

### **42.1 Scope of Work**

The scope covers the design, manufacture, transportation, installation, testing and commissioning of the fixed type of High Mast lighting system including high mast Tower and fittings for use at XXX Power station of NHPC Limited.

### **42.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

i)	Maximum ambient temperature (Deg. C)	:-	-----
ii)	Minimum ambient temperature (Deg. C)	:-	-----
iii)	Maximum relative humidity (%)	:-	-----
iv)	Height above Sea Level (m)	:-	-----

### **42.3 Functional Characteristics:-**

- The mast shall be complete with all the components & accessories including Head Frame & Pulley assembly, Winch Bracket, Lantern Carriage Ring, resting Bracket, Guide Ring, Compensating Disc, Lightning Arrestor, Aviation light, LED fittings, Safety Wire Rope, internal Cable, Foundation accessories, double drum winch, Two (2) point suspension system with stainless steel wire rope of 6 mm diameter (7 / 19 construction), integral reversible power tool for its operation etc.
- The top height of mast shall be at 18 m. Shaft shall be delivered in two sections, and shall be joined together by slip stressed-fit method at site. No site welding or bolted joint shall be done on the mast. The High mast shaft shall have only one longitudinal weld without any circumference weld. The minimum overlap distance shall be 1.5 times the diameter at penetration.
- The mast shaft shall be fabricated from steel plates confirming to BS EN 10025 or equivalent with metal protection through hot dip galvanization and thickness of galvanization should not be less than 80 microns.
- The mast shall be capable of safely withstanding the wind speed of 180 KMPH (50 m/s) with minimum plate thickness at bottom & top of 5 mm & 4 mm respectively having minimum dia. of base & top as 450 mm & 150 mm respectively.
- The High mast shall be of continuously tapered, polygonal cross section, 20 sided, presenting a good and pleasing appearance, assured performance, and reliable service.
- The bottom section shall have close fitting door of size 1200 mm x 300 mm with Allen key bolts and pad lock arrangement
- Galvanized Lantern carriage arrangement shall be suitable for minimum eight (8) symmetrically fitted luminaries each comprising of LED fittings of minimum 2 x 200 W suitable for high mast

### 43 PUMP STARTER PANEL

#### 43.1 Scope of Work

The specification covers the supply of Pump starter panels for use at XXX Power station of NHPC Limited.

#### 43.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification:

Sl. No.	Standards	Description
1.	IEC 292.1	Starters and contactors
2.	IS 13947-1	Low-voltage switchgear and control gear, Part 1: General rules
3.	IEC 61439	Specification for low-voltage switchgear and control gear assemblies

#### 43.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

#### 43.4 Functional Characteristics (To be customised by Power Station as per requirement)

##### 43.4.1 Constructional Details

- i) Panel shall be complete with Bus Bars, MCCBs module, MCCs, instrument transformers, Ampere meters with selector switch, Voltmeters with selector switch, Energy meters with 4-20 mA signal for SCADA, protection system, cabling, wiring and other accessories.
- ii) The load bearing member & Gland plate of panel shall be constructed with CRCA steel of minimum thickness 3 mm and other member of panel with CRCA steel of minimum thickness 2 mm
- iii) The board shall be provided with terminal blocks for incoming / outgoing circuits, earthing terminals, mounting brackets, circuit directory plate & circuit diagram fitted on the inside door etc.
- iv) The panel / board shall be fitted with close fitting, hinged, lift-off doors capable of being opened through minimum 120 deg. The doors shall be provided with door handles with integral lock and master key. The doors shall have PU seal for perfect sealing and longer life and shall be vermin proof
- v) It shall be Powder coated / painted both inside & outside with minimum thickness of 90 micron.
- vi) Removable gland plate shall be provided for bottom entry of cables / conduits.
- vii) The panel shall be provided with nameplates, identifying the purpose of the panel and all of its components



- viii) Panels shall be provided with a ground bus with 40mm x 5mm or higher (as per requirement) copper bar extending throughout the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm<sup>2</sup>.
- ix) The standard phase arrangement when facing the front shall be RYB from left to right, from top to bottom and front to back.
- x) All instruments, control knobs and indicating lamps shall be flush mounted on the panels. Relays and other devices sensitive to vibration shall not be installed on doors or hinged panels, and no equipment shall be installed on rear access doors.
- xi) Choice of MCCB / MCB
  - Draw-out type MCCB shall be provided in incoming feeders for floor standing type panel
  - Fixed type MCCB shall be provided in incoming feeders for wall mounting type panel
  - Fixed type MCCB shall be provided in all outgoing feeders having ratings greater than 32 A
  - Fixed type MCB shall be provided in all outgoing feeders having ratings less than or equal to 32 A
- xii) Starter for motors having ratings 7.5 KW or above shall be provided with thermal type overload & phase failure relays
- xiii) Starter for motors having ratings less than 7.5 KW shall be provided with thermal overloads only
- xiv) All motors having ratings 7.5 kW or above shall be provided with Ammeters to read current in one phase

#### 43.4.2 Design Consideration

##### A) Service Voltage and Mode of Starting

The service voltages and corresponding power ratings for electric motors to be used in the Project shall be as follows:

- i) 3 phase Motors
 

1	Service voltage	3-phase a.c. 415/240 V, 50 HZ
2	Mode of starting	direct-on-line up to 50 kW above 50 kW with suitable soft starters
- ii) Motors up to 0.75 kW
 

1	Service voltage	single-phase a.c. 240 V, 50 HZ
2	Mode of starting	Condenser
- iii) Motors intended to work on the d.c. System
 

1	Service voltage	220 V D.C.
2	Mode of starting	Resistor

##### B) Service Factor

The service factor, being the ratio of the installed motor output to the required power at the shaft of the driven machine at its expected maximum power demand, shall be applied as follows:

<b>Sl. No.</b>	<b>Power Demand of Driven Machine</b>	<b>Service Factor</b>
1	Up to 5 kW	1.2
2	More than 5 kW	1.1

#### **43.4.3 Specific Technical Parameter**

1	Rating of Motor	To be Provided by Power Station
2	Incoming Supply	415V, 3-Phase, 4 wire, 50 HZ / 240 V, 1-Phase, 50 HZ (To be Provided by Power Station)
3	Type of Mounting	Floor mounting / Wall Mounting (Mounting / Cut-out details to be provided by Power Station)
4	Minimum IP Class	IP-54
5	Colour Shade of Panel	To be provided by Power Station
6	Cable Entry	Bottom
7	Size of cable	Size / Current requirement to be provided by Power Station
8	Other specific Details	To be provided by Power Station

## 44 BATTERIES AND BATTERY CHARGERS

### 44.1 Scope of Work

The specification covers the design, manufacture and supply of Batteries and Battery chargers for use at XXX Power station of NHPC Limited.

### 44.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification.

Sl. No.	Standards	Description
1.	IEEE Std 485	IEEE recommended practice for sizing Lead Acid batteries for stationary applications.
2.	IEC 60146	Semiconductor converters.
3.	IEC 60439	Low-voltage switchgear and control assemblies.
4.	IEEE Std 1115	IEEE recommended practice for sizing Nickel Cadmium batteries for stationary applications

### 44.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 44.4 Functional Characteristics

The Battery and Battery chargers shall meet the following technical requirement:-

#### 44.4.1 Batteries-

1.	Type of Battery	Lead Acid Plante type	Nickel-Cadmium
3.	No. of cells / battery	As per site requirement	As per site requirement
4.	Nominal cell voltage	2.0 V	1.2 V
5.	Cell Float voltage	2.25 V	1.42 V
6.	Nominal end cell voltage	1.85 V at 10 hour rate	1.14 V at 5 hour rate
7.	Minimum Capacity of each battery bank at 25°C	XXX Ah at 10 hour discharge rate to 1.85V/cell	0.8 times XXX Ah at 5 hour discharge rate to 1.14V/cell

#### 44.4.2 Battery Chargers-

1.	AC Power supply	415 +/- 10 %V, 3-phase, 4 wire
2.	Frequency	50+/- 5% Hz

3.	Nominal DC output voltage	220V adjustable		
4.	Voltage Regulation	+/-1%(From no load to full load)		
5.	Ripple of output voltage (peak to peak) With / without battery connected	< 1 %		
6	Minimum Current rating of 220V Charger	Lead Plante	Acid	Nickel Cadmium
a)	Float charger	150A		150A
b)	Boost Charger	210A		240A

#### 44.5 Standard features

##### 44.5.1 Batteries

- i) The Battery cells shall have removable top cover and a float to show the electrolyte level in the battery.
- ii) The polarity of the terminals shall be marked for identification. Positive terminal may be identified by 'P' or a (+) sign or red colour mark and negative terminal may be identified by 'N' or (-) sign or blue colour mark. Marking shall be permanent and non-deteriorating
- iii) The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuations of load.
- iv) Vent plugs shall be provided in each cell. They shall be of anti-splash type, having more than one exit hole and shall allow the gases to escape freely but shall prevent acid from coming out.
- v) Containers shall be robust, heat resistant, leak proof, non-absorbent, alkali resistant, non-bulging type and free flaws such as wrinkles, Cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on containers.

##### 44.5.2 Battery chargers

- i) Dry type transformers and static type rectifiers shall be used throughout.
- ii) The battery charger cubicle shall be provided into separate compartments for each of the twin battery chargers and the respective main circuit breakers.
- iii) The charger cubicles shall be provided with a protection class of at least IP 42.
- iv) The chargers will be protected against harmful overload by a drooping characteristic, which transfers all loads in excess of the capacity of the chargers to the battery.
- v) The battery chargers shall be connected in parallel with the corresponding battery through the main distribution bus bar.
- vi) The chargers shall be completely equipped for a fully automatic and controlled charging and floating charge of the batteries, and shall be of the constant voltage type with current limiting devices.
- vii) Complete control and supervision equipment such as circuit breakers, ammeters, voltmeters, earth leakage meters and alarm indicating devices shall be incorporated with each charger.

At least following alarm devices shall be provided for alarm/indication on the charger.

- AC Mains Fail
- Charger Failure
- AC & DC Over voltage
- DC Under voltage
- DC Ground Fault

Necessary alarm / potential free contacts shall be provided for remote indication and alarm at SCADA.

The battery charger shall have provision for automatic temperature compensation of charging current. The equipment shall have provisions for testing the ground resistance alarm device on both poles (plus and minus).

**44.6 Drawing & Manual:**

The supplier / bidder shall submit following drawings / documents:-

- i) Technical Data sheets of all equipment.
- ii) Drawings– GA, SLD, BOM, Mounting arrangement etc. of all equipment.
- iii) Catalogue with Discharge characteristics chart of Batteries (K-factor).
- iv) Type Test certificates for all equipment as applicable issued from Govt. approved lab.
- v) Operation and maintenance manual of all equipment

## **45 EPABX SYSTEM**

### **45.1 Scope of Work**

The specification covers the supply of EPABX system for use at XXX Power station of NHPC Limited.

The microprocessor based (digital) EPABX system shall comprise of:

- i) XXX lines EPABX system
- ii) UPS

### **45.2 Functional Characteristics**

#### **45.2.1 EPABX System**

- The system shall be fully automatic microprocessor based, standalone modular system with one touch line / feature selection and flexible user friendly programmable push buttons.
- The system shall support full duplex voice and data transmission on a twisted pair line.
- The system shall have redundant power supply in hot swappable redundant mode without call drops.
- The system shall have at least 72 (or to be specified) subscriber ports with future expandability of another 72 (or to be specified) ports.
- The system shall have minimum 8 (or to be specified) line port (P&T).
- The system shall have OLTE card/ optical modem for direct termination of optical fibre line.
- The system shall be capable for VOIP transmission with minimum features of P & T line connectivity, PA system connectivity, Call transfer, Call back, Call forwarding, Account code, Group calling, Conference facility, automatic Voice prompt facility, Messages wait lamps etc.
- EPABX system shall be provided with dedicated UPS of sufficient capacity for minimum 3 hours power back up facility in order to maintain the supply in case of power failure.
- The available power supply for the EPABX system shall be 415V / 230 V AC.

#### **45.3 Drawing & Manual:**

The supplier / bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, dimensions and characteristics of the system including instruction / user manual of the system.

## **46 TELEPHONE SET**

### **46.1 Scope of Work**

The specification covers the supply of following type of Telephone sets for use at XXX Power station of NHPC Limited.

- i) XX Nos. Analog Push button telephone set
- ii) XX Nos. Telephone set with alphanumeric CLIP facility LCD display
- iii) XX Nos. Twin set (Plan 1+1) Caller ID telephone set
- iv) XX Nos. Wall mountable slim telephone handset
- v) XX Nos. Wall mountable slim telephone handset with CLIP facility LCD display

### **46.2 Functional Characteristics**

#### **46.2.1 Analog Push button telephone set**

The instrument shall be complete with all accessories and shall have following minimum features:-

- Tone / Pulse dialling mode switchable
- Ringer volume control switch (High/ Medium/Low)
- Ringer indicator
- Last number redial
- Pause, Flash, Mute / Hold buttons
- Desk / Wall mountable
- All the required accessories like – Removable line connector cord / Coil cord (RJ11), coil cord, Rosette boxes and instruction / user manual should be provided along with the equipment.
- Colour – To be provide by Power Station
- Manufacturer warranty – 1year

#### **46.2.2 Telephone set with alphanumeric CLIP facility LCD display**

The instrument shall be complete with all accessories and shall have following minimum features:-

- 16 digit, 3 line backlight effect with alphanumeric LCD display
- 5 step LCD contrast adjustable
- FSK / DTMF compatible caller ID
- The telephone set should be operational on telephone line power (not on battery)
- Real time clock with year, month & date display in standby mode, also call duration display
- User selectable Ringer tone (min. Two distinctive rings)
- 3 level ringer volume control adjustable (High / Mid / Low)
- Ringer / Message waiting indicator
- Programmable Flash selectable timing (100-1000ms)
- Toggle mute

- Redial facility
- Two way speaker phone - Hands free answer & dialling
- 50 Name phonebook memory
- 8 one touch memory
- Log memory with name matching / missed calls for 50 incoming calls & 10 Outgoing calls
- Alarm function
- All the required accessories like – Removable line connector cord / Coil cord (RJ11), coil cord, Rosette boxes and instruction / user manual should be provided along with the equipment.
- Colour – To be provide by Power Station
- Manufacturer warranty – 1year

#### **46.2.3 Twin set (Plan 1+1) Caller ID telephone set**

The instrument shall be complete with all accessories and shall have following minimum features:-

- Single line Twin set (plan 1+1) Caller ID corded phone.
- Boss Secretary telephone set feature
- The telephone set should have the facility to display Caller Line Identification (CLIP) facility on both the phones
- The phone should have intercom facility
- The phone should have external call transfer facility from either end
- Private talk security feature
- Minimum 16 digit LCD display, room temperature display
- Alphanumeric Monochrome display with backlight
- Minimum Three one touch memory feature
- Two way speaker phone - Hands free answer & dialling
- All the required accessories like – Power adopter, extended line cord, coil cord, Rosette boxes and instruction / user manual should be provided along with the equipment.
- Colour – To be provide by Power Station
- Manufacturer warranty – min. 1year

#### **46.2.4 Wall mountable slim telephone handset**

The instrument shall be complete with all accessories and shall have following minimum features:-

- Tone/Pulse dialling mode switchable
- Telephone set should be Wall-mountable
- Ringer volume control switch (High/ Low)
- Ringer indicator
- Big Key buttons



- Last number redial
- Pause, Flash, Mute/Hold buttons
- All the required accessories like – Removable line connector cord / Coil cord (RJ11), coil cord, Rosette boxes and instruction / user manual should be provided along with the equipment.
- Colour – To be provide by Power Station
- Manufacturer warranty – 1year

#### **46.2.5 Wall mountable slim telephone handset with CLIP facility LCD display**

The instrument shall be complete with all accessories and shall have following minimum features:-

- Slim line corded phone
- 1 Line of 7 segment and 1 line icons numeric LCD display
- Date and time display in standby mode
- Big Key buttons
- Tone/Pulse dialling mode switchable
- Handset volume levels (high/mid/low)
- Telephone set should be Wall-mountable
- Ringer volume control switch (High/ Low)
- Ringer indicator
- Last number redial
- Pause, Flash, Mute/Hold buttons
- All the required accessories like – Removable line connector cord / Coil cord (RJ11), coil cord, Rosette boxes and instruction / user manual should be provided along with the equipment.
- Colour – To be provide by Power Station

## **47 PUBLIC ADDRESS SYSTEM**

### **47.1 Scope of Work**

The specification covers the supply of Public address (PA) system for use at XXX Power station of NHPC Limited.

Public address system shall comprise:

- i) Master Control Station (MCS) including microphone and all accessories required for the system,
- ii) Central control unit consisting of Central switching system (CSS), Central paging control and amplifier rack, preamplifier, power amplifiers and all required accessories,
- iii) Field call stations consisting twenty (20) nos. telephone set with wall / column / structure mounting arrangements, etc.
- iv) Loud speakers (Cone Type-20 / Horn type 25) with wall / column / structure mounting arrangements,
- v) Head microphones,

### **47.2 Functional Characteristics**

#### **47.2.1 General**

Public address system shall be a microprocessor controlled software programmable, centralized amplifier based system. System shall be comprised with two main channels:

##### **A) Page channel:**

This provides loud speaking facility and is used to broadcast / announce messages, instructions and to locate field people in the plant. The loudspeakers can be arranged in different groups and the announcements can be made either in individual group or all groups.

##### **B) Private channel:**

It shall be used for carrying prolonged conversations in private mode, which shall not be heard over the loudspeakers. The system possess multiple party channels i.e. one dedicated channel for each field handset station.

#### **47.2.2 Master control station (MCS)**

Master Control Units shall be microprocessor based and of modular design. It shall be desktop type construction and installed in the control room.

The MCS shall be comprised of the at least following-

- i) Two (2) dynamic microphones,
- ii) All zone / Individual zone selection switches,
- iii) Field paging 'ON' indication,
- iv) Siren access,
- v) Press to talk switch,
- vi) Digital display for identification of calling station number,
- vii) Dial key pad,
- viii) Hands free dialling,
- ix) Monitor the functionality and status of individual field handset stations,
- x) Automatic fire alarm tone generation

It shall possible that during an emergency, control room operator can broadcast siren/ alarm tone in selected or all zones. Control room operator shall have page priority over the paging from field.

#### **47.2.3 Central control equipment**

Central control equipment shall be located in the control room.

##### **A) Central switching system (CSS)**

CSS shall be in non-blocking architecture and based on TDM / PCM technology or state of art technology which shall have improved speech quality, the noise interference and the distortion is reduced to minimum.

##### **B) Central paging control and amplifier rack**

The racks shall be designed for free floor standing. The system shall have high reliability amplifiers with built in protection circuitry. The system shall be provided with standby amplifier with changeover circuitry to ensure continuous operation at all times. The system shall have provision in the amplifier for further expansions to meet the requirements. The rack shall have preamplifier with built in MIC and AUX input, Control panel, Power supply unit, Individual / all zone selection switch, Chime module, siren access, Priority matrix, etc.

Central paging control and amplifier rack shall have solid state, class-B, Push-pull type Power amplifiers fully conforming to IS: 10426 or equivalent international standard.

Total harmonic distortion shall be less than 1% at rated output at 1 KHz, Signal / Noise ratio shall be 60 dB.

All the heat generated devices shall be operated well within their rated limits to minimize the thermal stresses. The temperature sensors shall be provided on the heat sinks to monitor the temperature. The Amplifier shall be comprised of at least following minimum features:

- i) Mains power supply,
- ii) Mix and match capabilities,
- iii) Adjustable sensitivity as volume control with facility for coarse and fine setting,
- iv) Bass and treble control
- v) Electronic protection

#### **47.2.4 Field handset stations**

The field handset station shall be weather-proof and located / installed at multiple locations in the indoor and outdoor field. These shall be wall / column / structure mounted.

The handset stations in the noisy areas shall be housed in acoustic hoods. The design noise level within the hood shall be limited to a maximum of 60 db SIL.

Handset transmitter / microphone shall be noise cancelling type for effective communication from noise areas. The handset shall consist of push button type keys, handset cord and external canopy in fibre for extra protection. Handset transmitter / microphone shall have filters to protect from dust. The weather-proof station for outdoor areas shall be made of corrosion resistance aluminium alloy.

#### **47.2.5 Loudspeaker**

The loudspeaker shall be weather-proof and located/installed at multiple locations in the indoor and outdoor field. These shall be wall / column / structure mounted.

Capacity and bandwidth ( $\pm 3\text{dB}$ ) for wall / column mounted horn type loudspeakers shall be at least 15W (rms) and 500 -4500 Hz respectively.

Capacity and bandwidth ( $\pm 3\text{dB}$ ) for wall / column mounted cone type loudspeakers shall be at least 4W (rms) and 100-7000 Hz respectively.

Loudspeaker shall have control switch to vary the loudspeaker output. Its cabinet shall be treated with acoustic under-coats to prevent resonance.

#### **47.2.6 Junction boxes**

Junction boxes shall be used for connecting field handset stations, loudspeakers, etc. from central equipment. The Junction box shall be constructed with suitable locking arrangement. All junction boxes shall have minimum 20% spare terminals for future requirements.

Junction box shall be of 4-way type having opening on each side. The degree of protection shall be minimum IP-55. Disconnecting (sliding) cage clamp type terminal blocks shall be provided, to facilitate testing and maintenance without disconnecting the cables.

#### **47.3 Drawing & Manual:**

The supplier / bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, dimensions and characteristics of the system

## **48 EXTENSION PANEL**

### **48.1 Scope of Work**

The specification covers the supply of extension Panel for use at XXX Power station of NHPC Limited.

### **48.2 Standards and Regulations:**

The following standards with latest amendment would apply to the specification:

<b>Sl. No.</b>	<b>Standards</b>	<b>Description</b>
1.	IS 13947-1	Low-voltage switchgear and control gear, Part 1: General rules
3.	IEC 61439	Specification for low-voltage switchgear and control gear assemblies

### **48.3 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

### **48.4 Functional Characteristics**

The extension Panel shall be same as low- voltage switchgear and control-gear assemblies defined in IEC 61439-1 or EN 61439-1 built up from compartments housing circuit breakers, control gear, relays, bus bars, controls and other equipment.

#### **48.4.1 Constructional details**

The extension Panel shall be metal enclosed indoor cubicles free floor standing type.

The cubicle assemblies shall be designed in accordance with the recommendations of latest IS/IEC with protection class IP42 according to IEC Publication 60529. The cubicles shall be type tested as per the standard IEC 61439.

Hinged doors and removable covers shall be provided wherever necessary to allow access to all equipment. The frame of the cubicles shall be sufficiently sturdy and the metal sheeting of sufficient thickness to ensure safe transport, mounting and operation without deformation or bulging. Natural ventilation as required shall be provided. Provision for future expansion of cubicles shall be made in end cubicles.

Suitable pressure relief devices shall be provided to minimize danger to operator during internal fault conditions. The design should have undergone internal Arc tests for different types of feeders. Continuous lifting angle or lifting hooks shall be provided to facilitate the installation of the cubicles.

Mounting details, Floor cut outs, details of existing panel to which the extension panels will be connected etc. shall be provided by power station.

#### **48.4.1.1 Compartments**

Each cubicle shall be divided into sections, or compartments, housing the incoming, interconnecting or outgoing feeder air circuit breaker units and

moulded case circuit breaker units respectively. Degree of protection within compartments shall be at least IP2X. Each ACB and MCCB unit shall be mounted on a carriage assembly, constructed so that the unit can be removed and replaced while the buses are energized. The carriage shall have self-engaging definite position stops for disconnected, test and connected positions. All necessary means shall be provided for easy removal and handling of the unit.

#### **48.4.1.2 Cable compartments**

All feeders to and from the cubicle assemblies will be connected through cables. The assemblies shall be accessible for the cables from bottom to each feeder circuit breaker via separate cable compartment. Solder less connectors shall be furnished for each power conductor entering the equipment. Provisions shall be made to clamp and fasten cables in the cable compartment. Terminals for cable connection will be suitable for Aluminium cables.

#### **48.4.1.3 Wiring**

All secondary and control wiring shall be done with stranded copper wires, current transformer secondary leads shall not be less than 4.0 sq. mm. All control wiring within the assembly housing shall be installed at the manufacturer's premises.

All connections shall be made with solder less lugs. All wires and connections to remote equipment shall be wired to terminal blocks.

**49 BUS BARS**

**49.1 Scope of Work**

The specification covers the supply of Bus bars of LT Panel for use at XXX Power station of NHPC Limited..

**49.2 Standards and Regulations:**

The following standards with latest amendment would apply to the specification:

Sl. No.	Standards	Description
1.	IEC 60890	Sizing of the bus bar
3.	IEC 61439	Specification for low-voltage switchgear and control gear assemblies

**49.3 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

**49.4 Functional Characteristics**

- i) Bus bar conductors shall be made of copper.
- ii) A continuous bus of the same cross section as the main bus shall be furnished and connection of ample size shall be brought to each feeder compartment, for bolted connection of the feeder.
- iii) Cross section area, current & voltage rating shall be specified by the power station
- iv) Phase arrangements shall be R-Y-B from top to bottom, from back to front and from left to right when facing the front of the equipment.
- v) All bus bars shall be clearly marked by engraved letters.
- vi) Adequate provisions must be made for the expansion and contraction of the bus bars and other bus bar connections with variation in temperature. Bus bars shall be so arranged that they can be extended in length without difficulty.
- vii) All field connections shall be bolted. The connections shall be kept as short and straight as possible.
- viii) Bus bars, connections and their insulating supports shall be of approved construction, mechanically strong and shall withstand all the stresses, which may be imposed upon them under ordinary working conditions due to vibration, temperature fluctuations, short circuit or other reasonable causes.
- ix) The bus bars shall be supported on non-breakable, non-hygroscopic epoxy resin or glass fibre reinforced polymer insulated supports able to withstand operating temperature of 110 0C at regular intervals, to withstand the forces arising from short circuit or other reasonable causes.

## 50 STARTER & CONTACTORS

### 50.1 Scope of Work

The specification covers the supply of contactors for use at XXX Power station of NHPC Limited.

### 50.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification:

Sl. No.	Standards	Description
1.	IS/IEC 60947-4-1	Contactors and motor-starters - Electromechanical contactors and motor-starters
2.	IEC 61439	Specification for low-voltage switchgear and control gear assemblies

### 50.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

### 50.4 Functional Characteristics

- i) Contactors shall comply with IS/IEC 60947-4-1 or EN 60947-4-1.
- ii) Contactors shall be electro-magnetically controlled, double air-break type.
- iii) Contactors shall be four-pole, triple-pole, double-pole or single-pole as specified by Power Station. The mechanical endurance of the contactors shall not be less than 3 million no. load operating cycles. Contactors shall be silver-faced.
- iv) Current & Voltage ratings shall be specified by the Power station
- v) Mounting details shall be provided by power station
- vi) Motor starters and contactors shall be equipped with short circuit protection and local disconnecting devices.
- vii) Starters and contactors shall comply with IEC 292.1 and be suitable for direct on-line starting, uninterrupted electrical duty, and capable of 30 operations per hour.
- viii) Starters and contactors shall be capable of satisfactory operation, without damage, for a period of 5 minutes at a voltage 25 per cent below nominal, at nominal frequency
- ix) They should be suitable for the addition of auxiliary contacts and other electrical auxiliaries without any compromise on the performance or the operation of the contactors.
- x) The control contactors for power factor correction equipment shall be of quick break and have a high arc resistance during switching operation.
- xi) The contactors shall have an un-interrupted rated duty and utilization category of at least AC3 at 415V and 50 Hz. The contacts should be of fast opening and fast closing type.



- xii) The making and breaking capacity values of the contactors should be as per IEC 60947-4)
- xiii) The contactors should be capable of frequent switching and should operate without derating at 60°C for AC3 applications. They should be climate proof. The coil of the contactor should have class H insulation to support frequent switching.
- xiv) The rated voltage of the contactor and the rated insulation voltage shall be 690V. The rated Impulse voltage of the contactor should be at least 8 KV.
- xv) Wherever DC control is required, the contactor should have wide range (0.7 to 1.25 U<sub>c</sub>) DC coil with built in interference suppression as required.
- xvi) The control and power terminals should be at separate layers preferably with colour coding (black for power and white for control). All contactors power connection shall be finger safe (IP 2X)
- xvii) They should be capable of being integrated into automated system (PLCs) without any interposing components in the minimum operating conditions.
- xviii) Contactors used with surge suppressor.
- xix) Starter for motors having ratings 7.5 KW or above shall be provided with thermal type overload & phase failure relays
- xx) Starter for motors having ratings less than 7.5 KW shall be provided with thermal overloads only

## 51 MCCB (MOULDED CASE CIRCUIT BREAKERS)

### 51.1 Scope of Work

The specification covers the supply of MCCBs for use at XXX Power station of NHPC Limited..

### 51.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification:

Sl. No.	Standards	Description
1.	IS13947(Part-2) / IEC 60947-2	Moulded Case Circuit Breakers
3.	IEC 61439	Specification for low-voltage switchgear and control gear assemblies

### 51.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 51.4 Functional Characteristics

- i) The MCCBs shall be designed in accordance with the IEC Publications 60947-1 and 60947-2. All MCCBs shall be manually operated and shunt trip type.
- ii) MCCB shall be housed in individual metal-enclosed compartments.
- iii) ON, OFF TRIP position of MCCBs should be indicated.
- iv) MCCB's to be provided in LV Main Switchboard shall be stored energy type motorized and Suitable for Remote operation.
- v) Method of connection: Fixed / draw-out type. Mounting details shall be provided by power station
- vi) Draw out type MCCB shall be mounted on a carriage assembly with wheels running on tracks secured to the inside of the compartment. The carriage shall have self-engaging definite position stops for disconnected and connected position. Means shall be provided for easy removal and handling of the units. A mechanical interlock shall prevent moving of the MCCB from the connected position, while the breaker is closed, and prevent the access door being opened unless the breaker is in withdrawn position.
- vii) All MCCB's should have front adjustable microprocessor based releases with adjustment in the range of 40 - 100% for nominal overloads and adjustable setting for short circuit faults.
- viii) MCCB's for network/feeder Protection shall have releases with earth Fault Protection features, wherever and as indicated by the Power Station.
- ix) In case of 4 pole MCCB, neutral shall be defined and capable of offering protection up to full rating with possibility of adjustment at site in the neutral setting.

- x) All MCCB's shall be arranged for padlocking in OFF positions with lock provided.
- xi) A shunt trip coil shall be provided to facilitate automatic tripping and local manual tripping. The manual trip device shall be fitted with the means of padlocking. The shunt trip coil shall be suitable for operation within a voltage range of 70% to 110% of the rated AC power supply voltage.
- xii) The trip unit shall be easily replaceable in the same MCCB without changing the MCCB.
- xiii) The time delay on overload tripping shall be inversely proportional to the over current up to a threshold value of approximately six to seven times the rated current at rated working temperature.
- xiv) Contacts shall be non- welding type. The operating mechanism should be trip-free and provided with mechanical "ON", "OFF" and "TRIPPED" indicator.
- xv) Handle position shall give positive indication of 'ON' 'OFF' or 'TRIPPED', thus qualifying to disconnection as per IEC 60947-3 indicating true position of all the contacts.
- xvi) The operating mechanism of MCCB's shall be Independent of the operating speed of the over centre toggle and the MCCB shall be of current limiting type and comprise of Quick make and Quick break switching.
- xvii) The MCCB shall be designed for both vertical and horizontal mounting, without any adverse effect on electrical performance. Remote closing and tripping coil should be of continuous duty cycle.
- xviii) MCCB's shall have common field fittable auxiliaries for the entire range and above 250 A the accessories like copper spreaders and phase barriers should be the integral part of the MCCB's.
- xix) MCCBs shall meet the following requirements:
  - Number of poles: double-pole, triple-pole or four poles as specified by the Power Station
  - Rated operational voltage: 240 / 415 V AC
  - Rated insulation voltage: 660 V AC, higher voltage acceptable
  - Rated uninterrupted current (In): as specified by the Power Station, but after taking into account the installation conditions and temperature deration.
  - Rated frequency: 50 Hz,
  - Rated short-circuit making capacity (Icm): shall be at least 2.1 times of ultimate short circuit breaking capacity at 0.25 power factor,
  - Rated ultimate short-circuit breaking capacity (Icu): 65/50/35 kA (min),
  - Rated: service short-circuit breaking capacity (Ics): 65/50/35 kA Further, Ics must be equal to 100% Icu for the selected breaker,
  - Utilization category: A or B as appropriate,
  - Degree of protection: IP 3X to IEC 60529 or EN 60529, and
  - Impulse Withstand Voltage - 8KV

## 52 MCB (MINIATURE CIRCUIT BREAKERS)

### 52.1 Scope of Work

The specification covers the supply of MCBs for use at XXX Power station of NHPC Limited.

### 52.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification:

Sl. No.	Standards	Description
1.	IEC 60898	low-voltage circuit breakers – MCBs
3.	IEC 61439	Specification for low-voltage switchgear and control gear assemblies

### 52.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 52.4 Functional Characteristics

- i) MCBs shall comply with and be type-tested to IEC 60898 or EN 60898.
- ii) The load handling contacts shall be silver / tungsten or proven material and the contacts and operating mechanism shall be designed so as to give a wiping action both at make & break.
- iii) The breaker operating mechanism shall be of trip- free type.
- iv) The breaker operating dolly shall be clearly indicated for the "ON" and "OFF" positions. It should be of Quick make and Quick break type.
- v) Circuit protection against overload and short-circuit conditions shall be provided by means of thermal-magnetic device.
- vi) Double-pole, triple-pole, and four pole MCBs shall be integral units and interlocked internally so that an over current through any pole shall trip all the poles of the MCB simultaneously.
- vii) All DP, TP and FP circuit breaker shall have a common trip bar and should be mechanically coupled through a pin.
- viii) Housing shall be heat resistant and having high impact strength.
- ix) It shall have an electrical endurance of the order of 10000 operation cycle for current rating of up to 50A.
- x) MCBs shall meet the following requirements:
  - Number of poles: single-pole, double-pole, triple-pole or four-pole as specified by the Power Station
  - Method of connection: Bolted type or clip-on type
  - Mounting details shall be provided by power station
  - Rated operational voltage and frequency 240 / 415 V AC and 50 Hz.

- Rated current: 6 A, 10 A, 16 A, 20 A, 25 A, 32 A, 40 A, 50 A, as specified by the Power Station
- Range of instantaneous tripping current: MCB's shall be current limiting Type Class 3 with range of instantaneous tripping current B, C or D type as specified,
- Rated short-circuit breaking capacity: not less than 10 kA (M3)
- $I^2t$  characteristic: suitable for load and circuit being protected,
- Degree of protection: IP-20 for MCB's
- MCB's shall have minimum power loss (Watts) per pole as per the IEC and should be proven by published value by manufacturer.

**53 FUSES**

**53.1 Scope of Work**

The specification covers the supply of Fuses for use at XXX Power station of NHPC Limited..

**53.2 Standards and Regulations:**

The following standards with latest amendment would apply to the specification:

Sl. No.	Standards	Description
1.	IS: 13703-1	LV Fuses for voltages not exceeding 1000 V ac or 1500 V dc, Part 1: General requirements
3.	IEC 61439	Specification for low-voltage switchgear and control gear assemblies

**53.3 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m) :- -----

**53.4 Functional Characteristics**

- Switch fuse units shall have quick-make, quick-break silver plated preferably double break contacts with operating mechanism suitable for rotary operation in the case of cubicle mounting.
- All switches shall be rated as specified by the Power Station and shall withstand the system prospective fault current let through.
- Cam operated rotary switches with adequate terminal adaptors up to 25A are acceptable but for all higher rating switch fuse units shall be heavy-duty type.
- Fuses shall be HRC cartridge type conforming to IS: 13703 - 1993 with a breaking capacity corresponding to system fault level.
- Fuses shall be link type with visible indication. Screw type fuses are not acceptable for any ratings.
- All disconnects shall consist of switch units quick-make, quick-break type with silver plated contacts.
- The switches shall preferably have double breaks. The switches shall preferably have sheet steel enclosure, which in turn is mounted on suitable angle iron frame work.
- In wet locations enclosures shall be IP56 rated. Disconnects shall have a minimum breaking capacity of 5KA at 415 Volts.
- Switch contacts shall be designed with arc repelling features to extinguish the arc quickly to provide long contact life.

## 54 TERMINAL BLOCKS

### 54.1 Scope of Work

The specification covers the supply of Terminal blocks for use at XXX Power station of NHPC Limited..

### 54.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification:

Sl. No.	Standards	Description
1.	IEC 61439	Specification for low-voltage switchgear and control gear assemblies

### 54.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 54.4 Functional Characteristics

- i) Terminal blocks for low voltage wiring shall be moulded from high-grade non- hygroscopic melamine, comprise bank of rail-mounted blocks with all live parts fully shrouded, screw- clamp, spring loaded insertion, solder-lug or stud type terminals as appropriate to the design and duty of the cables to be terminated.
- ii) Each terminal shall be provided with claw-type washers, crimp lugs or other approved means for connection of the wires. Plain and spring washers, nuts and lockouts shall be electro-tinned.
- iii) Terminals for final connections for indication, instrumentation and metering circuitry shall have test probe facilities and an integral disconnecting device to facilitate testing.
- iv) Labels shall be provided adjacent to the terminal block to identify the function and voltage of each group.
- v) All terminals to which 240 V or 415 V AC circuits are connected, where they are in individual terminal blocks, shall be provided with a transparent insulated cover which in addition to any other form of identification and shall have a label engraved suitably indicating the voltage.
- vi) All terminals shall bear a permanent identification number or letter.
- vii) The insulating material of Terminal Block should be of polyamide 6.6 meeting VO/V2 inflammability Class as per UL94. All metal parts including screws should be of copper alloy.
- viii) The Terminal Block should be suitable for mounting on both 'DIN' as well as 'G' type rail. All the metal parts should be captive and touch proof.
- ix) The Terminal Block should have screw locking design so that it can withstand vibration level up to 5g and also prevent accidental loosening of conductors.

## 55 PROTECTION & AUXILIARY RELAYS

### 55.1 Scope of Work

The specification covers the supply of Numerical relays for use at XXX Power station of NHPC Limited.

### 55.2 Standards and Regulations:

The following standards with latest amendment would apply to the specification:

Sl. No.	Standards	Description
1.	IEC 60255	Electrical relays
2.	IEC 61869-3	Instrument transformers - Inductive voltage transformers
3.	IEC 61869-2	Instrument transformers - Current transformers
4.	IEC 61643	Surge Protection Devices.
5.	IEC 61850	IEC 61850- Communication Networks & Systems in Substations

### 55.3 Climatic Conditions:

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### 55.4 Functional Characteristics

#### 55.4.1 General

All devices shall remain inoperative during internal faults and transient phenomena. They shall be insensitive to mechanical shocks, vibration and external magnetic fields. All relays shall be suitable for local reset. They shall have self-monitoring facilities and LED status indication.

Service voltage failure and any fault in relays and tripping circuitry shall be indicated. Tripping circuits shall be operable at 70% nominal voltage. CTs shall be shorted automatically, when relevant modules are withdrawn. Main and back up protection system shall be separated and shall have individual power supply from different source.

The relays shall be provided with the following information, suitably located:

- i) Function of relay,
- ii) Phase identification,
- iii) Main characteristics.

#### 55.4.2 Protection and Tripping Relays

- Relays shall be of approved types with IEC 60255 or British Standard 142 and IS 5992 (Parts 1, 2 & 3), as appropriate, fully tropicalized and shall have approved characteristics.
- The protection relays shall be located in panels with protection class IP54 and shall be mounted inside the panel with glass door on the front for



making the relays visible from outside without opening the door. Panel cut out details shall be provided by Power station.

- The protection class of the cover for all relays or protection systems, in which the modules are mounted, shall not be inferior to IP52.
- Any auxiliary supplies needed shall be drawn from the main station batteries and not from the separate internal batteries in the protection equipment. All relays shall be adequately protected against damages from incoming surge and shall meet relevant IEC, BS, IS and ANSI SWC test standards.
- The input circuit must be galvanically isolated from the electronic circuits. Potential free output contacts must be suitable for the direct control of breaker trip coil.
- The trip circuit supervision scheme shall provide continuous supervision of the trip coils and trip circuits with the circuit breaker in either the open or the closed position and scheme shall have sufficient contacts for visual/available alarm and indication.
- Provision shall be made in trip circuit supervision circuits to prevent any type of mal-tripping of a circuit breaker.
- Relay alarm should be equipped with well resetting indicators.
- The numerical protection relays shall have an operating time of less than 20 ms and single function protection relays shall have the operating time less than 15 ms. The total time taken by the protection system including auxiliary and tripping relays to send trip command to circuit breaker from the occurrence of the fault shall not exceed 70 ms.
- Each relay or relay assembly shall have a test device, which facilitates checking the correct functioning of the equipment during operation or stand still.

#### **55.4.3 Auxiliary relays**

- The relay modules (consisting of relays, base etc.) shall be DIN rail mountable and must have self-locking type Screw terminals. Screw terminals shall be made of polyamide 6.6 meeting VO/V2 inflammability Class as per UL94. All metal parts including screws shall be of copper alloy. Each relay module shall also have necessary signalling and protection circuitry on-board.
- Each relay shall have self-resetting potential free contacts of suitable rating as needed for connection in the tripping circuits and at least two self-resetting potential free contacts for local and remote alarm and supervision, both wired to terminals.
- All relays shall be clearly marked with the corresponding relay function.
- The Auxiliary relay modules must be Pluggable and must be with status indication and other necessary protection like diode protection etc.

#### **55.4.4 Numerical Relay**

The numerical relay shall have at least following features

- All the inherent characteristics like- Simplicity, Flexibility, Reliability, Selectivity, Stability, Accuracy, Sensitivity, and Redundancy.
- All relays including ancillary devices such as interposing transformers, tripping matrix & relays, test facilities, power supply units, etc. with all circuits shall comply with IEC 60255 recommendation,

- Provision for communication with the station control system (SCADA) and relay workstation through relay network based on universally accepted Protocol namely IEC 61850.
- The relay shall be microprocessor based and shall be controlled by programs. The protection device shall have provision for human machine communications interface. The programs should be externally user-friendly for operation by the operator. It should prompt the user with messages and confirmations in order to guide the user and avoid errors or incorrect situations.
- Necessary provision / ports for Local connection of Laptop for change in settings / downloading the data etc., inter connection of relays as well as for remote setting / auto extraction of disturbances / events etc., Transfer of parameter settings etc. from / to external device.
- Preferably front panel back lit display,
- Self-diagnosis & supervisions functions to ensure maximum availability of the protection device as well as the system. Any failure of hardware or software shall be signalled out immediately by alarm contacts. The external and internal auxiliary supplies should be continuously supervised. Special algorithms should be incorporated to check the processor's memories regularly, to check the execution of the programs etc.
- The operator program shall be suitable for configuration and setting of the protection, listing parameters, reading events, and listing the various internal diagnostic data. Provision shall be there for the user to create logical combinations of signals and pick-up and reset delays. Provision for detection of system asymmetric e.g. in the secondary circuits of CTs and VTs shall be made.
- All major numerical relays shall have an inbuilt disturbance recorder and event recorder. DR shall have at least 8 Analog and 16 Digital channels with a scan rate of minimum 1000 Hz. The output of DR should be available on COMTRADE format to enable replay on Numerical test kits.
- In addition to inbuilt disturbance recorder, the distance relay shall have features of fault distance locator, MW, MVAR, current and voltage display,
- The event recorder shall be capable of storing a minimum of 256 digital signals including time marker with a resolution of one millisecond.
- All relays, disturbance recorders, event recorders etc. shall be time synchronised through universal time synchronisation system

## **55.5 Protection Features**

### **55.5.1 Generator protection**

The following features shall be furnished for the generator protection:

#### **A) Generator Differential Protection**

The generator differential protection shall be three phase current adaptive changed and high stability through fault. This shall be highly sensitive for internal faults and operating time shall necessarily be very short period to minimize the possible damage.

Setting range: 10 to 50 % of  $I_n$  in steps of 5% of  $I_n$ .

This protection shall not operate in the presence of magnetizing in-rush current and be capable of rapid tripping in the event of energizing onto a fault. It shall detect and trip all phase and earth faults within the protection zone

and shall remain stable for all faults outside the area limited by the relevant current transformers.

The pick-up ratio shall be adjustable. The tripping time shall be less than 40 ms at a differential current equal to five times nominal setting current. The bias and basic sensitivity shall be adjustable in steps.

**B) Reverse Power Protection**

The typical setting values would be the following:

Reverse power	:	0.5 -5%
First stage time delay	:	0-100 sec
Second stage time delay	:	0-100 sec

**C) Back up Impedance Protection**

Back up impedance protection shall be provided with two circular zones, each with two separate independent definite programmable time delays. This shall be used as a backup protection. The operation of back up impedance protection shall necessarily be blocked in case of failure of voltage supply to the measuring unit.

**D) Stator Thermal Overload Protection**

Stator thermal overload function shall be based on  $I^2t$  measurement and provided with a memory of the thermal condition of the stator. Its characteristics shall be closely matched to the generator stator winding. Varying cooling medium temperatures shall be taken into account. The heating and cooling time constants shall be settable.

**E) Loss of Field and Out of Step Protection**

This protection shall be provided to protect the generator from unintentional opening of field circuit breaker, opening or short-circuiting of field circuit and a fault in the automatic voltage regulator or excitation system.

The protection scheme shall detect the condition of loss of excitation and operate before the generator falls out of synchronism within a short time. In order to obtain a rapidly effective under excitation protection, as a second criterion the excitation voltage shall be introduced into the system. If both, the stability curve and the excitation voltage criteria are satisfied, alarm and trip shall be triggered after an adjustable time delay of 1-2 seconds. The loss of synchronism with the excitation being in normal operation shall be detected by an integrator, which detects the periodical entering of the vector into the instability zone.

**F) Negative Phase Sequence Protection**

This protection shall distinguish between an asymmetrical load and an asymmetrical fault. It must always trip after the fault tripping relays. It shall protect the rotor iron from excessive heating and trip the generator before the permissible  $I^2t$  value will have been reached. Two set levels shall be available. One fixed time for alarm and one inverse delayed for tripping.

**G) Over Current Instantaneous and Time Delay Protection**

Three-phase over current protection shall be provided for stator to avoid exceeding its current limits. Both instantaneous and inverse characteristic can be employed as applicable and necessary.

**H) Over Voltage Protection**

This protection shall protect the generator against over voltages produced within the generator, for example by a failure of the voltage regulator. The relay shall operate independent of the frequency within the range of at least

0.8 - 1.2 times rated frequency. The relays shall be provided with two independent stages for delayed and instantaneous trip.

**I) Under Voltage Protection**

This protection shall be used as a back-up protection against loss of excitation. It shall have a time-delayed stage. It shall operate independent of the frequency within the range of 0.5-1.2 times rated frequency. Typical setting and tripping ranges would be the following:

Setting range: 0.5 to 1-0 UN Tripping time: 0-100 s

**J) Field over Voltage Protection**

This protection shall be used for over voltage of field. The setting for field over voltage shall be based on generator manufacturer.

**K) Stator 100% Earth Fault Protection**

A complete protection of the stator winding from short-circuits between the stator winding in the slots and the stator core shall be provided based on injection principle. False operation must be prevented assuring reliable discrimination between a fault in the stator circuit and other transient phenomena.

**L) Stator 95% Earth Fault Protection**

The protection scheme shall necessarily be designed to cope with the way the generator is connected to the network.

**M) Under / Over Frequency Protection**

The scheme shall have a working range of 45 - 65Hz and an adjustable time delay of 0.5 to about 5 sec.

**N) Generator Voltage Transformer Fuse Failure Monitoring Protection**

This shall be provided for blocking of protection scheme, which may mal operate in the event of PT fuse blowing in primary side or secondary side. It shall be of voltage balance or equivalent type. It shall have sufficient contacts to block tripping of those relays, which are voltage dependent and give alarm.

**O) Rotor Earth Fault Protection**

Rotor earth fault protection shall be provided to detect the earth fault and to trip the machine with a short time delay.

**P) Rotor Excitation Circuit over Current Protection**

An IDMT three phase over current protection shall be installed on the excitation transformer feeding side to protect the alternating current section against short circuits.

**Q) Shaft Current Protection**

For detection of current in the generator main shaft, which could damage the bearings, a shaft current protection device shall be supplied, including a suitable current transformer to be connected to the test points in the generator bearings

**55.5.2 Generator Transformer protection**

The following features shall be furnished for the generator transformer protection

**A) Overall Differential Protection**

Transformer overall protection shall be provided for the detection of phase and earth faults on the transformer windings. The overall protection shall be of the three winding biased differential type fed from current transformers on

the high voltage side of transformer winding and the generator neutral and Excitation transformer and Unit Auxiliary Transformer side.

The scheme shall have magnetizing inrush current restraint of the harmonic type and shall have individual adjustment of operation and bias settings.

All necessary interposing transformers shall be provided which shall be adequately rated to ensure correct relay performance during maximum through-fault condition.

The minimum operating settings shall not be more than 20 per cent of rated full load of the current transformers.

**B) Restricted Earth Fault Protection**

Transformer windings and connections shall be protected by restricted earth fault (REF) protection; relay shall preferably have an independent measuring unit and the necessary protection against over voltages. Each relay shall have an instantaneous trip attachment. The fault setting shall be between 10 per cent and 60 per cent of the rated current of the protected winding.

The rated stability limit shall not be less than the maximum current available for an external fault. This shall be taken as 16 times the rated current. Separate current transformers (i.e. not sharing transformer biased differential protection) are preferred.

**C) Over Fluxing Protection**

This system shall protect the generator transformer iron core from excessive heating in case of voltage rises and/or frequency dips during unit operation.

**D) Buchholz Protection**

All oil type transformers shall be fitted with Buchholz devices of the two-element type giving operation under gassing and under surge conditions.

**E) Oil and Winding Temperature**

Transformers will be provided with oil and winding temperature protection. These will be of the two stage type with adjustable settings giving alarm and trip facilities.

**F) Time Delay Phase Over Current Protection**

This protection covers phase over current in transformer HV side and adjacent network.

**G) Transformer protection shall also include:**

- i) Differential pressure Oil/water alarm and trip,
- ii) Sudden pressure release alarm and trip
- iii) PRD alarm and trip.
- iv) Low/high oil level alarm,
- v) Low oil and water flow alarm.

**H) Arrangement of Transformer Protection Trip Circuits**

Transformer protection tripping circuits shall be arranged as follows to form two complementary groups.

Sl. No.	Group 1.	Group 2.
1.	Generator Transformer biased differential (I)	Generator Transformer biased differential (II)

2.	GT neutral over current and trip.	Phase over current and trip
3.	Winding temperature trip	Oil temperature trip
4.	Buchholz main tank	HV winding REF
5.	Pressure Relief Tripping	Sudden pressure release trip
6.	Differential pressure alarm and trip	Moisture in oil
7.	Over fluxing protection	Dissolved gas trip
8.	Backup directional over current and earth fault protection (HV side) or impedance protection	Backup directional over current and earth fault protection (LV side) or impedance protection
9.	Fire Protection	Fire Protection

Each trip relay shall be arranged to operate onto both trip coils on the circuit breaker.

### 55.5.3 GIS protections

GIS protection shall be of high speed, low impedance, circulating current type capable of detecting three phase, phase to phase and phase to earth faults, under all system conditions of plant operation. The operating time of the measuring relays shall be as short as possible consistent with reliable and secure operation.

The bus bar protection shall be fed from separate CT cores reserved for it.

#### A) Bus Bar Supervision Protection

Automatic and continuous supervision of current transformer circuits shall be provided to give an alarm when the out-of-balance current reaches an undesirable value. Operation of current transformer supervision equipment should block the protection after a time delay and shall initiate an alarm.

#### B) Bus Bar Differential Protection

Three phase bus bar differential protection including the number of systems and auxiliaries required for the complete bus bar protection system shown on the drawings.

The bus bar protection shall have the following features:

- a) The bus bar protection system shall have two criteria. One is to check overall bus differential current without using isolator contacts. The other criteria are to check discriminating zone bus differential current with isolator contacts.
- b) Bus bar protection shall be comprised of main zone-1 and main zone-2 protection relays for bus 1 and bus 2 respectively.
- c) Each circuit-breaker trip relay shall be arranged to trip both trip coils on the circuit breaker. In the case of feeder circuits, operation of LBB shall initiate direct transfer tripping of the remote end circuit breaker via PLCC / OPGW link.
- d) Bus bar protection shall be provided for easy future bay addition.

Suitable voltage limiting devices should be provided as necessary. High speed differential bus bar protection shall cover following features:

- e) The rated stability limit shall not be less than the three phase symmetrical breaking capacity of the associated switchgear.

- f) The fault setting for any type of fault shall not exceed 30% of the minimum fault current available.
- g) Current transformer knee, point voltages shall not be less than twice the relay circuit setting voltage.
- h) The maximum peak voltage across current transformer secondary wiring shall not exceed 3kV under maximum internal fault conditions.
- i) Associated current transformers shall be class PS, low reactance type. Split core type current transformers will not be accepted.

**C) Breaker Failure Protection**

Breaker failure protection shall be fitted to all circuit breakers connected to the main bus.

The breaker failure protection on a circuit breaker shall be initiated by all the other protection devices, which normally initiate tripping of that breaker. In the event of the circuit breaker failing to open within a pre-selected time, the breaker failure protection shall initiate tripping of all adjacent CB's connected to the same bus bar, and direct transfer tripping of the line breakers, via tele-protection channels over PLCC / OPGW link, as appropriate.

Full selectivity shall be achieved for every bus bar zone, hence the replica of every feeder isolator, bus isolator, coupling circuit breaker shall be incorporated by using combinations of NO and NC contacts on each isolator or breaker.

**55.5.4 Overhead line protection**

The following features shall be furnished for the overhead line protection: -

**A) Distance Relay (Main-I & Main-II)**

Distance protection shall be non-switched numerical type, comprised of minimum four zone distance operation with inter-tripping and blocking being carried out over PLCC / OPGW link. Main-I and Main-II protection shall be provided with different principle / make/ model. The distance protection shall operate for all types of phase and earth faults. Separate phase and earth fault distance measuring elements shall be provided. Phase and earth fault compensation features shall be incorporated to ensure accurate distance measurement for all types of fault and to allow for variation in the path of earth faults on the system.

Zones 1, 2 & 3 shall operate only for faults in the protected direction. Under no circumstances shall the relay operate for reverse faults even when the voltage supplied to the relay falls to zero on all three phases. The relay characteristics shall ensure adequate fault resistance cover under minimum plant and single outage conditions. Zone 4 shall be non-directional and shall be capable of being independently offset in either directions or separate element to provide backup protection for local bus bar.

Starting shall be through by impedance measuring relays only (not by over current starting). The relay characteristic shall cover the protected line plus the longest line emanating from the remote station taking current in-feed into account. The starting relays shall not operate during maximum power transfer. During single phase to earth faults coinciding with maximum power transfer, only the starting relay associated with the faulted phase shall operate.

The reach of each measuring zone and starting relay shall be individually adjustable. The characteristic angle shall be adjustable between approximately 40 and 80 degrees.

Zone 2 and Zone 3 / Zone 4 shall have a time delay setting range of minimum 0.2 to 1.0 second and 0.5 to 3.0 seconds respectively. The sensitivity of the protection shall be adequate for definite operation under minimum plant and single outage conditions and shall not exceed 30% of rated current. The operating time of each zone shall be substantially independent of fault current magnitude.

A feature shall be incorporated to ensure instantaneous tripping in the event that the circuit breaker is closed onto a fault on a previously de-energized line. Steps shall be taken to protect the static circuitry from external impressed transient voltages, which could reach the station battery. The routing of cables should be such as to limit interference to a minimum. Any auxiliary supplies necessary to power solid-state circuits shall be derived from the main station battery and not from batteries internal to the protection.

A monitoring system shall be provided to supervise the voltage transformer supply to each distance relay. The secondary voltage of the VT shall be taken to the relay through a MCB with auxiliary contacts. In the event of a trip of the MCB, the monitoring shall inhibit relay operation and initiate an alarm.

The distance relay shall be able to operate in conjunction with the delayed auto re-closing relays. In addition to tripping contacts, the protection shall have, where necessary contacts for initiating auto re-closing signalling and alarms. The distance relays shall incorporate indicators to show the zone in which the relay tripped and the phase or phases, faulted. Indication must not be lost in event of a supply failure.

Each protection shall be suitable for single pole tripping and for use in the single & three phase auto re-closing scheme.

The protection and associated auto re-closure equipment shall incorporate whatever means are necessary to ensure that all measuring and starting elements in the healthy phases of the faulted line and all measuring elements on the parallel circuit remain reset during the single phase re-closing dead time. Additionally, the inter-phase fault measuring elements on the faulted circuit shall be stable in the presence of a heavy close-up earth fault. The methods used to ensure correct stability of healthy phase elements during single-phase times and during fault conditions shall in no way prejudice the ability of the protection and auto re-closing scheme to respond to faults during the dead time.

All distance relays shall have Power swing detection with a swing time of as low as 200 ms blocking function and Internal/External faults detection function. An electrical or optical port shall be provided to directly connect the signal to auxiliary channel of OLTE (optical line terminal equipment).

**B) Over voltage protection**

The transmission lines shall be protected for over voltage. The over voltage relay setting for over voltage steps from 100% to 120% in steps of 2.5% each for time delayed protection. For instantaneous over voltage protection, the setting will be 110% to 150%. Relay setting shall be decided after observing grid condition at time project commissioning

**C) Automatic Re-closing**

Three pole and / or single shot repetitive auto re-closing equipment shall be provided for overhead line circuit breakers, and shall include, where necessary, dead line and check synchronizing relays. Re-closing shall only take place on overhead line circuits and shall be initiated by following tripping by the distance relay Zone 1 equipment or on receipt of a permissive inter tripping signal in case of Zone 2.



The following modes of operation shall be selectable by means of a switch or switches:

- i) Single pole, high speed, auto re-closing only

Auto re-closure shall only be initiated in the event of a single phase to earth fault. All other types of faults shall result in three phase tripping without auto re-closing.

- ii) Three pole delayed re-closing only

Delayed re-closing shall only be initiated in the event of a single phase or two phase fault. Three phase faults shall result in tripping without auto re-closing.

- iii) Single pole, high speed and/or three phase delayed, auto re-closing as appropriate

- iv) No auto re-closing

Three phase tripping without auto re-closing shall take place for any type of fault. If a second earth fault occurs during the single pole auto re-close dead time, three phase tripping with subsequent delayed three pole auto re-closing shall take place if the auto re-closure selector switch is in the single pole re-close mode, three phase tripping with lockout should follow.

The high speed and delayed re-closing dead times have to be coordinated with the equipment being provided at the remote substation by others, and will be finalized only after Contract award. Tentative ranges are, however, as follows:

- High speed single pole re-closing dead time - 0.3 to 1 seconds.
- Delayed three - pole re-closing dead time - 1 to 30 seconds.
- The Contractor shall state available ranges.

A counting facility shall be provided to record the number of re-closures.

Dead line check relays shall monitor the conditions of the line and the bus bar and permit three pole re-closing only when the line is de-energized and the bus bar is energized. The line is considered de-energized when the voltage is less than 20 per cent of nominal operating voltage, and the bus bar is considered to be energized when the voltage is at least 80 per cent of nominal operating voltage.

## **55.6 Power Supply Requirements**

The protection systems shall be fed by the 220 V battery banks installed in the control block. All components of the protection system shall function properly at DC voltages from 80%-115% of nominal voltage. If short-circuit protection is needed inside each protection group, mini circuit breakers shall be used, having auxiliary contacts for initiating alarm for open position.

Each DC supply shall be designed to protect it from high voltage and surge and provide electrically isolated contacts for annunciation. Relays shall utilize a DC-DC converter type regulated power supply to provide transient surge isolation between the station battery and protection equipment. The supply units shall be equipped with input Class C type Pluggable Surge Protection Devices and filters to protect against external voltage peaks. Protection shall be provided in the primary and secondary circuits of the DC transducers. The supply voltage and all secondary voltages produced by the DC /DC transducers shall be monitored.

The protection systems shall have double in feed with main switch, DC /DC transducers, stabilizers and voltage monitors. Redundancy shall be obtained by de-coupling the two DC/DC transducers by diodes so that, on failure of

one circuit, the power supply can fully be maintained. In case of supply voltage drop the auxiliary voltage shall be maintained for 50 ms.

## **55.7 Other Ancillary Items of Protection system**

### **55.7.1 Relay Workstation**

Relay workstation shall serve the function of automatic pooling of disturbance recorder, reading & changing of relay settings / EL / PSL and sending them via email to external agencies / locations. Facility for recording & analysis of all types of relays shall also be provided.

The minimum basic hardware configuration shall have Octa core 3.2 GHz processor, 16 GB RAM (expandable up to 64 GB), 4GB display adapter card, 2 X 2 TB Hard Disk Drives, 1 X 22" monitor, Two 10/100/1000 Mbps Ethernet ports, other standard ports (USB/ HDMI / DVI / Bluetooth adaptors etc.), Standard keyboard and pointing device such as mouse / trackball etc. However, the same shall be of latest configuration available at the time of approval subject to their compatibility with the relays system.

The monitor shall be of coloured, full HD resolution, flicker free, flat screen LED backlit type. Special care shall be taken in designing the keyboards taking ergonomics into consideration.

The workstation shall be furnished with all connectors / interfaces necessary for its connection to the relay network and shall be preloaded with enterprise edition of windows operating system and Microsoft Office along with other application software required for performing its intended functions. Appropriate passwords and access rights shall allow the users to access relevant data. Any required measures as per IEC 62443/NERC-CIP guidelines shall also be provided for cyber security.

### **55.7.2 Laptop**

The Laptop shall serve the function of testing, recording & analysis of all types of relays used in the protection system.

The minimum basic hardware configuration shall have 17" display, Quad core 3.0 GHz processor, 16 GB RAM (expandable up to 64 GB), 2 GB display adapter card, 1 TB Hard Disk Drives, Two 10/100/1000 Mbps Ethernet ports, other standard ports (USB/ HDMI / DVI / Bluetooth adaptors etc.) including ports to be used for connectivity with relays / relay testing kit.

The laptop shall be furnished with all connectors / interfaces / cables necessary for its connection to the relays and shall be preloaded with enterprise edition of windows operating system and Microsoft Office along with other application software required for performing its intended functions.

### **55.7.3 Printers**

The printer shall be of heavy-duty, high speed, automatic A4 duplex, portable colour laser type. The printer shall have minimum 1200 MHZ processor, 256 MB RAM, USB port, 10/100 Mbps Ethernet ports, 2 line display, standard paper handling trays, print speed of at least 25 pages per minute with quality of 600 X 600 dpi and shall be compatible with window operating system.

## 56 CLOSED CIRCUIT TELEVISION (CCTV) SYSTEM

### 56.1 Scope of work

Scope of work covers the provision of labour, tools, plants, materials and performance of work necessary for the supply, installation, commissioning, necessary configuration / integration of the same with existing surveillance system, training of Employer's personnel and guarantee for one year or as per OEM standards, whichever is more, of CCTV system as per the specifications hereunder, complete with all auxiliaries, accessories and warranting a trouble free safe operation of the installation for use at XXX Power station of NHPC Limited

### 56.2 Detailed Scope of Works

The scope of work shall be a comprehensive functional system covering all supply and services including but not be limited to following (To be customised by Power Station as per requirement):

Sl. No	Items	Quantity
i)	IP based network camera	11 Nos.
ii)	4-chanel video encoder with H.264	4 nos.
iii)	Network video recorder	1 No
iv)	Network switch	3 No.
v)	CAT-6 Wall I / O with gang box & face plate complete	15 Nos.
vi)	1 Mtr. , CAT-6, Patch cord	30 Nos.
vii)	12 Port, CAT-6, Patch Panel	1 No.
viii)	Outdoor type UTP CAT-6 Cable (Roll of 305 m)	5 No.
ix)	Workstation without monitor	2 Nos.
x)	40" LCD high definition colour Monitor	3 Nos.
xi)	1 KVA Online UPS	2 No.
xii)	NVR software and other associated software for recording and viewing the cameras	1 Lot
xiii)	Any other equipment, hardware and software not mentioned explicitly but necessary for completion of the system	1 Lot
xiv)	Cabling , Installation of Encoder and IP Camera and integration / configuration with Existing System	1 Lot

### 56.3 Special Design and Layout Conditions

The intent of scope is to provide integrated CCTV system for Power House and Switchyard of XXX Power Station including necessary configuration / integration of the same with existing surveillance system. The CCTV system of all the zones will be seamlessly integrated for monitoring from security room in Powerhouse as well as Switchyard.

IP based network cameras shall be installed at Power House & switchyard of the XXX Power Station for the purpose of Security and surveillance. Some analog cameras are already installed at the said locations, which required to be integrated properly with the proposed digital system of IP based cameras, through necessary video encoders.

The system shall be integrated with the existing LAN system of the power station with necessary password security. Also, viewing of the video images on all the computers shall be ensured with password protections through LAN.

The Network Video Recorder (NVR) to record entire events of all the cameras (digital as well as analog) shall be installed at the main administrative building of the power station, approx. 4 Km from the switchyard / power house. One no. 40" high definition LCD monitor shall be installed with NVR for accessing the record / archives. Records / archives of CCTV system shall be accessible through password from other computers connected to network.

#### **56.3.1 Power House**

10 nos. analog cameras are installed at various locations of the power house and being monitored from security room of the power house. These analog cameras shall be integrated with the digital system through video encoder

Six (6) Nos. IP based cameras shall be installed at various location of power house in addition to already installed analog cameras.

One number workstation with necessary software along with 40" high definition LCD monitor shall be installed at security room of the Power House for surveillance. One online UPS at Power House shall also be installed for uninterrupted power supply to the workstations / Switches / cameras etc.

#### **56.3.2 Switchyard**

4 nos. analog cameras are installed at various locations of Switchyard and being monitored from security room of the switchyard. These analog cameras shall be integrated with the digital system through video encoder

5 Nos. IP based cameras shall be installed at various location of switchyard in addition to already installed analog cameras.

One number workstation with necessary software along with 40" high definition LCD monitor shall be installed at security room of the switchyard for surveillance. One online UPS at switchyard shall also be installed for uninterrupted power supply to the workstations / Switches / cameras etc.

#### **56.4 Power Supply Arrangement**

Three-phase system with grounded neutral for feeding three-phase and single-phase equipment (connected between phase and neutral) type TN-C 415 / 240V  $\pm$  10% and 50Hz  $\pm$  5% shall be made available by the Employer. All equipment should be designed to work continuously under  $\pm$  5% frequency variation and  $\pm$  10% voltage variation.

If the offered Equipment is operating at different voltage level other than as mentioned above, it will be the scope of the Contractor to furnish all required hardware to make the offered system compatible with the specified power supply arrangement without any additional financial implication the Employer.

#### **56.5 DESIGN & CONSTRUCTION**

The system shall consists of CCTV system for power house & Switchyard integrated seamlessly for monitoring from security room in powerhouse, Switchyard, Administrative office complex (IT Room) as well as from other computers on the network on basis of password level

of user. The system shall be suitable for installation & working successfully in Hydro Power plant environment.

The existing backbone network is made up of OFC. And the cabling between IP Camera and network switch should be via CAT 6 cable.

#### 56.5.1 Cameras

It shall be for outdoor purpose meeting the following minimum requirement to work properly in industrial and hilly environment:

SI. No	Parameter	Value
i)	Image Sensor	1 / 2.8" progressive scan CMOS
ii)	Lens	3-10.5 mm, 33"-92", Remote focus & Zoom, F1.4 P-Iris control, Autofocus- IR Corrected, automatic Day / Night Megapixel resolution
iii)	Minimum Illumination	Colour: 0.25 Lux @ F1.4 , B/W": 0.05 @ F1.6
iv)	Video Compression	H.264 High, Main and Base profiles, Motion JPEG
v)	Image Resolution	1920 x 1080 HDTV 1080p to 320x240
vi)	Video Streams	Multiple, individually configurable Streams in H.264 and Motion JPEG, Controllable frame rate and Bandwidth, VBR / CBR H.264
vii)	Image setting	Wide dynamic range-dynamic contrast, Manual shutter time, white balance, exposure control & zones, Backlight compensation, 20 configurable, Privacy mask
viii)	Pan / Tilt / Zoom	Digital PTZ
ix)	Corridor Format	Required with 9:16 ratio
x)	IR illumination	Optimized IR, with highly efficient LEDs with adjustable intensity and illumination. Range up to 15 mtr.
xi)	Event Triggers	Live stream accessed, Motion detection, Day / Night Mode, Camera Tampering, edge storage disruption, manual trigger, Alarm input Trigger, 3rd party analytics
xii)	Event Actions	File upload via FTP / HTTP / e-mail, Notification via email / HTTP / TCP, Video recording to edge storage, day / night mode 40 MB pre & post alarm video buffering
xiii)	Intelligent Video	Video motion detection
xiv)	Edge Storage	Built in SD card slot with support up to 64 GB with Class 10 speed
xv)	Storage	The Cameras shall have the feature to

SI. No	Parameter	Value
		directly record the videos/ images onto NAS without any Software
xvi)	Application Programmers Interface	The interface shall be available for integration with 3rd party analytics and applications
xvii)	Text Overlay	Date & time, and a customer-specific text, camera name, graphical image etc.
xviii)	Power requirements	Power over Ethernet IEEE 802.3af/802.3at Type 1 Class3, Max 11.2W
xix)	Operating Temperature	-30 °C to 50 °C
xx)	Enclosure	IP66-and NEMA-4X-rated casing (polyester polycarbonate blend)
xxi)	Certification	UL, CE, FCC, IEC,

### 56.5.2 Digital video encoder

The 4 channel Video Encoder shall comply with at least following features:

SI. No	Parameter	Value
i)	Video compression	H.264 Baseline and Main Profiles and Motion JPEG
ii)	Resolutions	720x576 to 176x120, 1536x1152 to 176x120 for quad view
iii)	Video streaming	Dual Streams at H.264/ MJPEG at full frame rate and resolution with controllable frame rate and bandwidth.
iv)	Image settings	Compression, Colour brightness, Contrast, Text & image overlay, Mirroring of images, Privacy mask, Aspect ratio correction, Enhanced de-interlace filter, Video termination, Anti-aliasing, Temporal noise filtering, Rotation: 90°, 180°, 270°
v)	Pan / Tilt / Zoom	100 presets / camera, Guard tour, PTZ control queue, Windows compatible joysticks
vi)	Audio	Two way, full-duplex, External microphone input or line input
vii)	Network	Password protection, IP address filtering, HTTPS encryption, IEEE 802.1X network access control, digest authentication, user access log
viii)	System Integration	Open API for software integration and shall support Triggers from Other devices without intervention of VMS

### 56.5.3 Network Video Recorder (NVR)

An enterprise class recording system shall be provided that can store and play back images from any number of cameras. These images shall

be transferred to a number of redundant arrays of independent disks (RAID) storage units for safekeeping and shall be possible to be recalled from view stations connected to network. There shall be provision for adding more no. of view stations, recorders and video storage units.

The recording system shall consist of following main components:

SI. No	Parameter	Value
i)	Type	Tower
ii)	CPU	Intel Atom or better
iii)	No of channels	32 cameras , expandable up to 64 cameras
iv)	Number of Drives	4 X SATA II
v)	Storage Per Drive	6 TB
vi)	Internal storage	24 TB
vii)	RAID Level	RAID 0,1, 5, 10
viii)	I/O Interface	6 X USB 2.0 (for mouse, UPS); 1 X eSATA (for DAS)
ix)	LAN	2 X Gigabit Port, RJ45
x)	Voltage	100-240V
xi)	Server Operating System	Windows / Linux
xii)	Client Operating System	Windows / Mac
xiii)	License Type	Professional
xiv)	Number of Camera per recording server	64
xv)	Recording Throughput	250 Mbps
xvi)	3 <sup>rd</sup> part Support	Point of sale, Access Control, License Plate Recognition
xvii)	Recording Type	Continuous record, trigger record by digital input, motion-triggered record, event-triggered record, boosting record, record by schedule, manual trigger record
xix)	Video Support	H.264, MJPEG, MPEG4, MxPEG, E-map, BMP, JPEG, GIF, PNG, TIFF etc.

#### 56.5.4 System setting, Management and Integration

- i) The system shall be Server-Client Architecture and centralizes all video data transaction only via server to remote clients.
- ii) The system shall include management server, recording server, metadata server, and client for configuring and viewing
- iii) System shall be able to manipulate camera views by changing its viewing angle and image size to allow for a seamless multi-pane panoramic view. 10 cameras shall be able to be set up as single view

- iv) System shall be able to automatically search for IP camera in the network with its brand & model.
- v) System shall have inbuilt Intelligent Search for Intuitive post-event motion search for suspicious areas on video and post-event 3rd party data keyword search then query related camera recording.
- vi) System should support the Multi-View so that Client PC can duplicate the same live view video onto multiple channels and digitally zoom in to see the details of different spots on cloned channels without losing the original live view video.
- vii) The system shall be able to synchronize time with NTP server (Internet Time Server)
- viii) The system shall support system status watchdog and automatically restart the system when abnormal event happened.
- ix) The management server shall be able to centrally manage all servers in the system including configuration, license management, and event monitoring.
- x) The system shall support unlimited channels of live viewing for video and metadata from 3rd party application.
- xi) The system shall support user priority of locking PTZ, Preset point and Patrol control. When PTZ control lock, only user with higher or equal control priority can unlock it.
- xii) The system shall support volume load balance, enabling user manually distributes cameras recording to different target volumes
- xiii) The system shall be able to backup recorded video to a remote FTP server according to pre-defined schedule as well as Manual backup / export.
- xiv) The system shall support viewing live video of IP cameras through operating system including Microsoft and Mac and Microsoft Internet Explorer browser, or Windows Firefox and also to view event notification on e-map
- xv) The instant playback shall enable user sync the video to playback instantly.
- xvi) The system shall provide optional layouts to display the videos - 1x1, 2x2, 3x3, 4x4, 5x5, 6x6, 7x7, 8x8, 1+5, 2+8, 1+12, 1+12 (central fixed), 1+16 (central fixed), full screen and customize layout.
- xvii) The system shall support digital PTZ on recorded video.

**56.5.5 Network Switch**

The network switch shall consist of following main components:

Sl. No	Parameter	value
i)	Configuration	10 / 100 / 1000 Base-T Port PoE + with 2 1G SFP port switch
ii)	Port Density	RJ-45 x 16 , SFP Combo: RJ-45 x 2 OR 100 / 1000 SFP x 2
iii)	Key Features	Switching capacity: Non- Blocking wire Speed performance, Supports 100/1000 Mbps SFPs, Bi-directional SFP Modules, IEEE 802.3az, Up to 8K MAC address table or more, 10/100/1000



Sl. No	Parameter	value
		TX ports shall support IEEE 802.3af Power over Ethernet (PoE) and at least 2 ports with IEEE 802.3 at (PoE+) to supply power to cameras, Switch shall have PoE budget of min 75W, VLAN IEEE 802.1Q, Port-based VLANs, IEEE 802.1d STP, IEEE 802.1w RSTP, MSTP, Port Mirroring, LLDP, IEEE 802.3 ad LACP
iv)	Performance	Non-blocking for all packet sizes, Non-blocking for all packet sizes, Dynamic VLAN assignment
v)	Management	Configuration backup/restore by FTP and HTTP, SNMP v1/v2c/v3, Web, SNTP, Syslog, SNMP Trap, RMON 4 groups.
v)	Security	IEEE 802.1x Authentication, Local authentication server(MD5), IEEE 802.1x Remote authentication through RADIUS & IEEE 802.1x Dynamic VLAN assignment, IEEE 802.1x MAC-based authentication.

#### 56.5.6 Workstations

Workstations are intended to be used as view station to view live or playback video from any camera at Power House as well as at Switchyard. The workstations shall be high performance systems. They shall be preloaded with enterprise edition of windows operating system & Microsoft Office along with other application software required for performing their intended functions.

The minimum basic hardware configuration shall have Octa core 3.5 GHz processor, 16 GB RAM (expandable up to 64 GB), 4GB display adapter card, 2 X 1 TB Hard Disk Drives, Two 10/100/1000 Mbps Ethernet ports, other standard ports (USB/ HDMI / DVI / Bluetooth adaptors etc.), Standard keyboard and pointing device such as mouse / trackball etc.

#### 56.5.7 High definition Colour monitor

40" LCD based full HD monitor will be used as a mean to monitor and view live picture from the CCTV cameras located at various sites with features like built-in speakers, automatic colour switching system, front panel controls, video and audio input and output, automatic degaussing, fast warming time etc.. The monitor shall have in-built HDMI / VGA / USB etc. connectivity.

Control features should include colour system select, volume, colour, brightness, contrast, power, video input select, etc.

#### 56.5.8 UPS

UPS of on-line type shall be suitable to feed the intended loads continuously. The UPS system shall have following features:

- Rated input voltage :- 170 V AC to 270V AC, single phase
- Rated output voltage :- 230 V AC, Single phase
- Voltage regulation :-  $\pm 1$  %
- Overload capacity :- 125% for 25 sec

- Termination :- Single phase, two wire with earth
- Make :- Numeric, APC and Emerson
- Battery back-up :- 30 minutes on full load
- PWM technology with IGBTs with built in galvanic isolation
- Pure Sine wave, with max. 5 % THD at linear load & max. 7 % THD at 100% non-linear load
- Multifunction LCD indication / LCD display system for UPS status, battery level, load level, line on, inverter on, by-pass, input & output voltage, input & output frequency, load level , battery level etc.
- Audible alarm system for AC failure, Battery Low, UPS fault etc.
- Electronic protection for output overload, short circuit, over temperature, Low battery, over charging, surge protection

### BILL OF QUANTITY

Sl. No.	Description of Items	Unit	Quantity
1	IP based CCTV system including IP based Cameras, Video encoder, Network video recorder, Network switch, I/O gang box, Workstations, Monitors, UPS, Cables, applicable software etc. as per defined scope & specifications	Lot	1
2	Installation, commissioning, necessary configuration / integration as per defined scope & specifications	Lot	1

## 57 OFFICE EQUIPMENT

### 57.1 Scope of Work

The specification covers the supply of following type of Office equipment for use at XXX Power station of NHPC Limited.

- i) XX Nos. Workstation
- ii) XX Nos. Printer
- iii) XX Nos. Photo Copier Machine
- iv) XX Nos. Scanner

### 57.2 Standard features

#### 57.2.1 Workstation

The workstation shall meet the following minimum technical / functional requirement (To be customised by Power Station as per requirement)

Chassis	Tower type
Processor	8 core, 3.5 Ghz, 8 MB L3 cache
Memory	16 GB RAM (expandable up to 64 GB), 24000 MHz DDR4 RDIMM ECC
Internal Storage	2 X 1 TB SATA 7200 rpm
Optical drives	DVD+/- RW drive (SATA) Optical Drive with dual layer writing capability
Graphics card	4 GB Dedicated
Audio	High Definition integrated audio with internal speakers
I/O Ports	Front : 1 headset connector; 2 USB 3.1 Gen 2 Type-C™; 2 USB 3.1 Gen 1 (1 charging) Rear: 1 audio-in; 1 audio-out; 1 PS/2 keyboard port; 1 PS/2 mouse port; 1 serial; 2 RJ-45 (1 GbE); 6 USB 3.1 Gen 1
Input devices	USB optical scroll mouse & USB standard keyboard
Networking	10/100/1000 on board Network port and inbuilt Dual Band 802.11a/b/g/n/ac Wi-Fi and Bluetooth 4.2 Combo
LED Monitor	A 23-24 inch Full HD, LED Backlit IPS monitor with HDMI & Display port connectors having Resolution of 1920X1080 (FHD), Aspect Ratio of 16:9, Viewing Angle of Up to 178° horizontal /178° vertical, Anti-glare, Height / Swivel adjustability and Pivot rotation along with one Display port, one HDMI and one VGA
Operating System	Genuine Windows 10 Professional 64-bit Operating System for workstation
Warranty	3 years comprehensive Onsite warranty through Authorised agency

### 57.2.2 Printer

The Printer shall meet the following minimum technical / functional requirement (To be customised by Power Station as per requirement)

Technology	Monochrome Laser / Colour Laser
Function	Print Only / MFP (Print, Scan , Copy)
Display	LCD
Connectivity	Hi-Speed USB 2.0, 10 Base-T/ 100Base-TX, IEEE 802.11b/g/n (Infrastructure Mode), IEEE 802.11g/n (Wi-Fi Direct)
Paper size	A3, A4, Letter, A5, A5(Long Edge), A6, Executive, Legal, Folio, Mexico Legal, India Legal
Print speed	25 PPM
Paper Capacity	250 Sheets x 1 Trays; 50 – Sheet By-pass Tray
Memory	Minimum 256 MB
Processor	Minimum 600 MHZ
Print resolution	Up to 1200 X 1200 dpi
User Interface Language	English
Power Supply	AC 230 + /- 10 % Volts, 50 Hz
Out put	Duplex
Duplex Printing	Automatic / Manual
Compatible Operating System	Window 7 & above

### 57.2.3 Photo Copier Machine

The Photo Copier Machine shall meet the following minimum technical / functional requirement (To be customised by Power Station as per requirement)

Technology	B/W Laser Multifunction
Function	Copier / Printer / Scanner
Display	LCD
Connectivity	Hi-Speed USB 2.0, 10 Base-T/ 100Base-TX, IEEE 802.11b/g/n (Infrastructure Mode), IEEE 802.11g/n (Wi-Fi Direct)
Duty Cycle	More than 25,000 Page / Month
Memory	Minimum 2 GB
Processor	Minimum 1 GHZ
Print resolution	Up to 1200 X 1200 dpi
Copy Resolution	Up to 600 X 600 dpi
Paper Capacity	250 Sheets x 2 Trays;

	50 – Sheet By-pass Tray
Paper Handling	Duplex Automatic Document Feeder
Media Type	Plain Paper, Bond, Punched, Paper Printed, Heavy weight, Light Weight, Recycled, Later Head, Custom
Paper size	A3 to A6, Letter & Legal
Zoom	25% to 400%in 1% Step
User Interface Language	English
Power Supply	AC 230 + /- 10 % Volts, 50 Hz
Copying resolution	600 X 600 dpi
Out put	Duplex
Duplex Printing	Automatic / Manual
Compatible Operating System	Window 7 & above

#### 57.2.4 Scanner

The Scanner shall met the following minimum technical / functional requirement (To be customised by Power Station as per requirement)

Scanner Type	Flatbed ADF
Technology	Monochrome / Colour
Scan resolution	Up to 1200 X 1200 dpi
Automatic document feeder Scan speed	25 PPM
Auto Document feeder capacity	50 Sheets
Memory	Minimum 256 MB
Processor	Minimum 500 MHZ
Connectivity	Hi-Speed USB 2.0 & USB 3.0
Display	LCD
Compatible Operating System	Window 7 & above
Paper size	A3, A4, Letter, A5, A5 (Long Edge), A6, Executive, Legal, Folio, Mexico Legal, India Legal
User Interface Language	English
Power Supply	AC 230 + /- 10 % Volts, 50 Hz

## 58 DIAL TYPE THERMOMETER (DTT)

### 58.1 Scope of Work

The specification covers the supply of XX nos. of DTT instruments for use at XXX Power station of NHPC Limited.

### 58.2 Functional Characteristics (To be customised by Power Station as per requirement)

#### 58.2.1 Constructional Details

- i) Dial scale shall be spread over 270 deg circumference.
- ii) Each DTT shall be supplied with setting Nob / Key and its mounting bracket with hardware.
- iii) Each DTT shall be packed individually

#### 58.2.2 Specific Technical Requirement

1	System	Liquid filled expansion type / Gas filled type etc. (To be specified by Power Station)
2	Type	Rigid Stem / Bulb with Capillary tube
3	Reference Standard	ASME B 40.200, EN 13190
4	Dial	100 mm / 150 mm etc. (To be specified by Power Station)
5	Mounting	Bottom Entry / Back Entry Panel Mounting / Surface Mounting (Mounting & Connection details to be specified by Power Station)
6	Protection Class	IP65
7	Accuracy	± 1% FSD
8	Temperature Range	0-100 deg C with graduation of 1 deg interval (To be specified by Power Station)
9	Working Temperature	40 to 80 deg C (To be specified by Power Station)
10	Over Range	125% FSD
11	No. of externally adjustable Pointers for additional contact	(To be specified by Power Station)
12	Colour of Pointers	
i)	Actual Value	Black
ii)	First Contact	Red
iii)	Second Contact	Green
13	Stem / Bulb OD	6 mm / 8 mm / 10 mm / 12 mm (To be specified by Power Station)
14	Stem / Bulb Length	To be specified by Power Station
15	Capillary Length	To be specified by Power Station
16	Application	Bearing Pad / Oil Pot etc.

17	Medium in which bulb to be inserted	Turbine Oil
18	Material	
i)	Casing	Stainless Steel
ii)	Stem / Bulb	Stainless Steel
iii)	Capillary	Stainless Steel
iv)	Armour	Stainless Steel / PVC
v)	Connection	Stainless Steel
vi)	Dial	Aluminium, Black Numerals on White Background
vii)	Pointer of actual value	Aluminium

**58.3 Drawing & Manual:**

The supplier / bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, dimensions and characteristics of the system.
- ii) The type test reports of the instruments from the Govt approved laboratory.

**59 RESISTANCE TYPE THERMOMETER (RTD)**

**59.1 Scope of Work**

The specification covers the supply of XX nos. of RTD instruments for use at XXX Power station of NHPC Limited.

**59.2 Functional Characteristics (To be customised by Power Station as per requirement)**

**59.2.1 Constructional Details**

- i) The element design shall be suitable for online replacement without removing thermo well
- ii) The element construction shall be mineral insulated filled with magnesium oxide (MgO) packed in SS 316 protection sheath.
- iii) Sensor wire size: 20 AWG
- iv) Element diameter shall be selected to fit in to thermowell without air gap for minimizing measurement lag. Element length shall be suitably selected to reach sensor at bottom of the thermo well.
- v) Thermowell Material shall be drilled bar stock SS316 or SS446.
- vi) Ingress protection shall be IP65 as per IS2147.
- vii) The RTD is to be supplied with sliding oil tight gland nut and all accessories as necessary for completion.

**59.2.2 Specific Technical Requirement**

Function	Online Temperature Measurement
Service	Suitable for Oil & Water
Assembly Type	Duplex PT100 TRD element with thermos well and head assembly with two cable entries
Element Type	Two independent PT 100 sensors with 3-wire system
Applicable standard	As per DIN 43760 or IEC 751
R/T Relationship	Conforming to IS 2848 Class B
Measuring Range	0 to 200 deg C

**59.3 Drawing & Manual:**

The supplier / bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, dimensions and characteristics of the system.
- ii) The type test reports of the instruments from the Govt approved laboratory.



## **60 KARL FISCHER TYPE MOISTURE MEASUREMENT KIT**

### **60.1 Scope of Work**

The specification covers the supply of portable Karl Fischer type moisture measurement kit including specified standard accessories for use at XXX Power station of NHPC Limited.

### **60.2 Climatic Condition**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- |      |                                      |    |       |
|------|--------------------------------------|----|-------|
| i)   | Maximum ambient temperature (Deg. C) | :- | ----- |
| ii)  | Minimum ambient temperature (Deg. C) | :- | ----- |
| iii) | Maximum relative humidity (%)        | :- | ----- |
| iv)  | Height above Sea Level (m)           | :- | ----- |

### **60.3 Functional Characteristics (To be customised by Power Station as per requirement)**

#### **60.3.1 Constructional Details**

- i) The Equipment shall be fully automatic, microprocessor controlled, compact, highly portable, designed for outdoor use instrument for measurement of moisture in mineral / transformer oil
- ii) The instrument shall operate on 230 V AC  $\pm 15\%$ , 50 Hz ( $\pm 5\%$ ), as well as on battery when on field and suitable. Rechargeable Battery pack for field operation up to 8 Hours shall be provided
- iii) The instrument shall have built in magnetic stirrer, Automatic Drift Compensation, Audio Signal indication for End Point of the Titration, Error Messages for problem regarding electrode, inbuilt report printer and RS 232 / USB port for data transfer to computer.
- iv) Statistical function like mean value, Relative and absolute standard deviation should be available for at least 15 determinations.
- v) The instrument shall have sufficient in-built memory to store at least 100 results at a time.
- vi) The instrument should be able to detect the sample presence and start on its own. This is to avoid any errors due to delay in starting the operation on field.
- vii) The instrument should have the facility to stop the Titration based on the drift apart from the time. This is to ensure zero errors due to external drifting conditions on the field.
- viii) The instrument shall be supplied along with all the accessories including rugged carry case and minimum 500 ml reagent for titration.

#### **60.3.2 Specific Technical Requirement**

Titration Method	Coulometric Karl Fischer Titrator
End Point detection	AC Polarisation
End Point Indication	Visual Display / Print out / Acoustic Beep
Type of sensor	Dual Platinum Electrode
Measuring Range	1 $\mu\text{g}$ to 10 mg of Water
Moisture range	1 PPM to 100 PPM

Resolution / Sensitivity	0.1 µg of Water
Accuracy	± 3 µg in 10 µg-1000 µg range and 0.3 % (maximum) above 1.0 mg
Display	40 Character Alphanumeric LCD Backlit Display
Key Board	Touch Key Board
Display format	ppm, mg / kg
Language	English
Printer	42 Character high speed Thermal Printer
Carry Case	Rugged Standard

**60.4 Drawing & Manual:**

The supplier / bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, dimensions and characteristics of the system.
- ii) The type test / calibration reports of the instruments from the Govt approved laboratory.
- iii) O & M Manual.

**61 REGENERATIVE DRY AIR SYSTEM**

**61.1 Scope**

The specification covers the design, manufacture, supply and delivery of Regenerative Dry Air System for use in Generator Transformer of units at XXX Power station of NHPC Limited.

The supply shall include, but not limited to the following:

- i) Screw compressor
- ii) Air Receiver Tank capacity of 500 litres/suitable capacity
- iii) Air Pressure Regulating Device
- iv) Air Drying Unit Twin Column Heatless Type Desiccant Dryer

**61.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- Maximum ambient temperature (Deg. C) :- -----
- Minimum ambient temperature (Deg. C) :- -----
- Maximum relative humidity (%) :- -----
- Height above Sea Level (m) :- -----

**61.3 Major Technical specification**

- Type- Regenerative type
- Capacity- 5 M<sup>3</sup>/min
- Operating pressure- 7 Bar
- Air dryer Unit- Twin Column Heatless Type Desiccant Dryer (With Special Filters) Rating: 5 M<sup>3</sup>/Min, Dew Point (-) 20°C ADP operating
- Dew Point sensor- Range- (-) 100 TO (+) 20° C
- The unit shall be suitable for 415 V, 3 PH, 4 wire, 50Hz AC Supply

**61.4 Installation & Commissioning of Dry Air System Equipment**

- Installation and commissioning of the Equipment at Site.
- Training at site for Customer's Engineers.

**61.5 Drawing & Manual:**

The bidder shall submit following information:-

- Manufacturer's leaflets giving construction details, schematic diagram, dimensions and characteristics of the system
- Field installation/commissioning manual.
- O & M Manual.

**62 VACCUM PUMP FOR TRANSFORMER EVACUATION SYSTEM**

**62.1 Scope**

The specification covers the design, manufacture, supply and delivery of Vacuum Pump For transformer Evacuation system for use in at XXX Power station of NHPC Limited.

**62.2 Climatic Conditions:**

The climatic conditions at site under which the material shall operate satisfactory are as follows

- i) Maximum ambient temperature (Deg. C) :- -----
- ii) Minimum ambient temperature (Deg. C) :- -----
- iii) Maximum relative humidity (%) :- -----
- iv) Height above Sea Level (m)

**62.3 Functional Characteristics**

- The pumps shall be in Roots-Rotary combination of the purpose of evacuation of Transformer.
- The pumps shall be of reputed make and the manufacturer of Roots and Rotary pumps shall be same in order to avoid any matching issues.
- The Vacuum Pumping System shall have McLeod Vacuum Gauge (Range: 10 Torr to 10 Microns), Bourdon Gauge (Range: 0 to 760 Torr), Isolation Valve, Airing Valve Mechanical Non Return Valve and Automatic bypass Valve for Roots Pump.

**A) Rotary oil sealed Pump (1 No.)**

- Nominal pumping speed - 1500 Ltrs/Min
- Ultimate Vacuum with G.B. Closed -  $5 \times 10^{-3}$  Torr
- Ultimate Vacuum with G.B. Open -  $5 \times 10^{-1}$  Torr

**B) Root Pump (1 No)**

- Nominal pumping speed - 500 M3/Hr
- Ultimate Vacuum -  $10^{-4}$  Torr

**62.4 Drawing & Manual:**

The bidder shall submit following information:-

- i) Manufacturer's leaflets giving construction details, dimensions and characteristics of the system.
- ii) Field installation/commissioning manual.
- iii) O & M Manual.