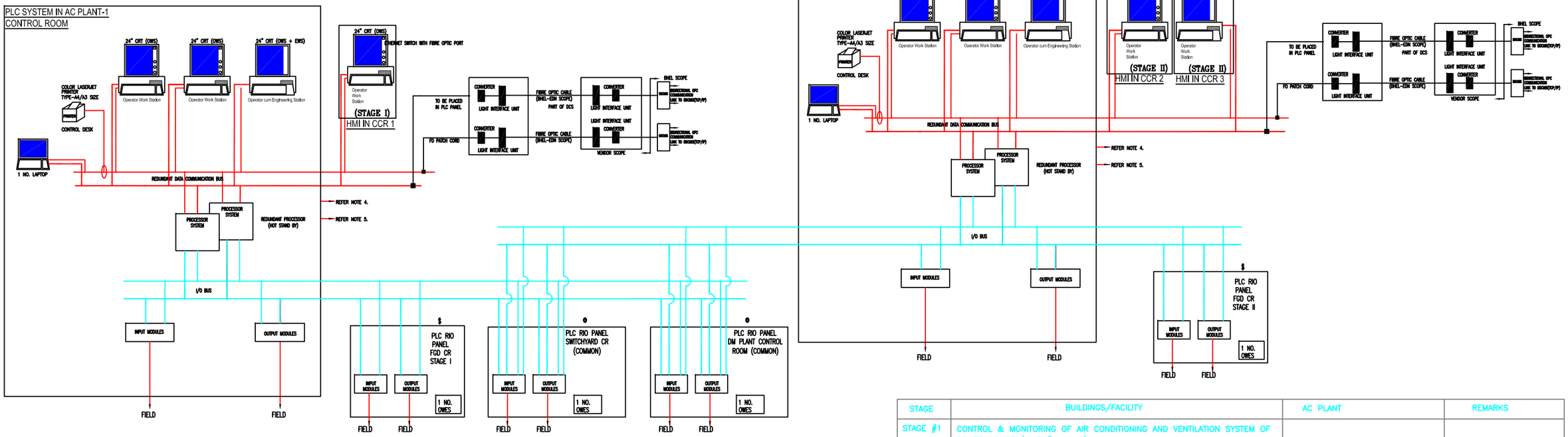
The PLC system shall be guaranteed to meet the performance requirement as specified and also for trouble-free continuous operation for 12 months from the date of commissioning or 18 months from the date of delivery at site whichever is later unless specified otherwise in Vol-IIB Section - B or Section - C.




NOTES:

1) TABLE TOP OWS/EWS SHALL BE 24"
2) ALL PLCS SHALL HAVE DUAL HOT REDUNDANT PROCESSOR AND EACH RACK SHALL HAVE DUAL POWER SUPPLY MODULES, DUAL NETWORK COMMUNICATION CARDS/MODULE FOR DUAL REDUNDANT RING OR DUAL REDUNDANT STAR NETWORK.
3) REDUNDANT UPS POWER SUPPLY SHALL BE USED FOR PLC PANEL(S),RIO, BACKUP PANELS, OWS/EWS,4 WIRE INSTRUMENTS AND NETWORK COMPONENTS.FOR APPLICABLE UPS SCHEME REFER DWG:PE-DG-417-145-1004
3A) UPS SHALL BE CONSIDERED STAGEWISE. STAGE #1 PLC, FGD-1 PLC RIO, SHALL BE FED FROM STAGE#1 UPS. STAGE #2 PLC, FGD-2 PLC RIO, SHALL BE FED FROM STAGE#1 UPS.
4) SWITCHYARD PLC RIO, DM PLANT PLC RIO SHALL BE FED FROM BOTH STAGE#1 & STAGE#2 UPS's.
5) PLC PANEL SHALL HAVE PROVISION TO ACCEPT TIME SYNC. SIGNAL (NTP/IRIG-B) FROM MASTER CLOCK SYSTEM.
6) PLC PANEL SHALL HAVE PROVISION FOR DATA EXCHANGE (OPC) WITH PLANT DCS. NECESSARY OPC CLIENT/SERVER SOFTWARE TO BE PROVIDED.SEPERATE OPC SERVER FOR EACH PLC SHALL BE PROVIDED.
7) NECESSARY PATCH CORD/CONVERTERS, LIU AT BOTH PLC AND DCS END SHALL BE IN BIDDER SCOPE FOR OPC LINK TO DDCMIS.
8) PLC SPECIFICATION SHALL BE AS PER KTPS TENDER SPECIFICATION VOLUME-VI, SECTION VI, SUBSECTION B ONLY
9) PLC PROCESSOR AND IO CARDS/MODULES SHALL BE FROM SAME FAMILY AND SHALL BE OF LATEST MODEL.
10) UPS SPECIFICATION SHALL BE AS PER KTPS TENDER SPECIFICATION VOLUME-V B,SECTION XIV.UPS SIGNALS TO PLC SHALL BE THROUGH HARD WIRED AND SOFT SIGNALS(MODBUS).
11) FIELD INSTRUMENT REDUNDANCY SHALL BE AS PER SPECIFICATION ONLY. PROTECTION & CLCS: TRIPLE REDUNDANCY; INTERLOCK/ PERMISSIVE:DUAL REDUNDANCY; MONITORING/ ALARM: SINGLE
12) ALL RTDS/ THERMO COUPLES IF APPLICABLE SHALL BE DUPLEX TYPE NECESSARY PATCH CORD, CONVERTERS, LIU ETC AT BOTH PLC AND DCS END SHALL BE IN VENDORS SCOPE.
13) VENDOR TO PROVIDE HIRSCHMAN MAKE ETHERNET SWITCHES ONLY

* - STAGE WISE i.e. STAGE I & STAGE II PLC PANEL IS ENVISAGED IN AC PLANT-1 AND AC PLANT-2 RESPECTIVELY.
$ - STAGE WISE i.e. STAGE I & STAGE II PLC RIO PANEL IS ENVISAGED IN FGD ROOM-1 AND FGD ROOM-2 RESPECTIVELY.
@ - COMMON PLC RIO PANEL IS ENVISAGED IN SWITCHYARD ROOM AND DM PLANT CONTROL ROOM WHICH WILL BE HOOKED UP WITH BOTH STAGE I AND STAGE II PLC PANELS.

| STAGE | BUILDINGS/FACILITY | AC PLANT | REMARKS |
|---|---|---|---|
| STAGE #1 | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF POWER HOUSE (UNIT # 1 & 2) | PLC IN AC PLANT-1 LOC: GROUND FLOOR OF POWERHOUSE-1&2 | |
| STAGE #1 | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF ESP BUILDINGS (UNIT # 1 & 2) | | |
| STAGE #1 | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF FGD CONTROL ROOM (STAGE # 1 ) | | RIO SHALL BE PROVIDED LOC: FGD MCC & CONTROL BLDG.#1 |
| STAGE #1 | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF SERVICE BUILDING (STAGE # 1 ) | | |
| COMMON | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF DM PLANT CONTROL ROOM | | RIO SHALL BE PROVIDED LOC: DM PLANT CONTROL ROOM |
| STAGE #1 | CONTROL & MONITORING OF V. SOFTENING PLANTS PROVIDED FOR AC PLANTS LOCATED IN ABOVE AREAS | | |
| COMMON | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF SWITCHYARD CONTROL ROOM | | RIO SHALL BE PROVIDED LOC: SWITCH YARD CONTROL ROOM |
| STAGE#2 | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF POWER HOUSE (UNIT # 3, 4 & 5) | PLC IN AC PLANT-2 LOC: GROUND FLOOR OF POWERHOUSE-3&4 | |
| STAGE #2 | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF ESP BUILDINGS (UNIT # 3, 4 & 5) | | |
| STAGE #2 | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF FGD CONTROL ROOM (STAGE # 2 ) | | RIO SHALL BE PROVIDED LOC: FGD MCC & CONTROL BLDG.#2 |
| STAGE #2 | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF SERVICE BUILDING (STAGE # 2 ) | | |
| COMMON | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF DM PLANT CONTROL ROOM | | RIO SHALL BE PROVIDED LOC: DM PLANT CONTROL ROOM |
| STAGE #2 | CONTROL & MONITORING OF V. SOFTENING PLANTS PROVIDED FOR AC PLANTS LOCATED IN ABOVE AREAS | | |
| COMMON | CONTROL & MONITORING OF AIR CONDITIONING AND VENTILATION SYSTEM OF SWITCHYARD CONTROL ROOM | | RIO SHALL BE PROVIDED LOC: SWITCH YARD CONTROL ROOM |

LEGEND: –

| | | | |
|---|---|---|---|
| PLC | – PROGRAMMABLE LOGIC CONTROLLER | LCR | – LOCAL CONTROL ROOM |
| DCS | – DISTRIBUTED CONTROL SYSTEM | CCR | – COMMON CONTROL ROOM |
| UPS | – UNINTERRUPTED POWER SUPPLY | OPC | – OLE PROCESS CONTROL |
| OWS/OEWS | – OPERATOR WORK STATION/ ENGINEERING WORK STATION | | |
| HMI | – HUMAN MACHINE INTERFACE | MCCB | – MOULDED CASE CIRCUIT BREAKER |
| NTP | – NETWORK TIME PROTOCOL | MCB | – MINIATURE CIRCUIT BREAKER |

| | | | |
|---|---|---|---|
| BHEL | PROJECT: 5 X 800 MW YADADRI TPS | DRG.NO. | PE-DM-417-145-1900 |
| | | DATE | 19.06.2020 |
| | TITLE: PLC CONFIGURATION AC/VENTILATION | REV.NO. | 03 |
| | | SHT | 5 OF 8 |

PEM :: C&I

# STANDARD QUALITY PLAN FOR PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 24.08.2007
SHEET 1 OF 8

| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency $ | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | W | V | |
| **1.0** | **Materials /Components** | | | | | | | | | | | |
| 1.1 | Panels & Control Desks | Physical Inspection for Dimensions, Painting, Cutouts, Lifting / Locking Arrangements, Components, Drawing Pocket, Mounting accessories, Plinth & AV Pads, Cable Gland Plates, Hardwares, Hinges, Louvers & Filters, Fans & Panel Lamps | MA | Visual | 100% | Contract specifications, Approved GA Drawings, BOQ | As per ref documents. No physical damage. | BHEL Quality Inspection Report. | 3/2 2 | | 1 | |
| 1.2 | Power Supply/Packs, Battery & Battery charger, Transformer, UPS. | Physical Inspection<br>Physical Damages<br>Dimensions<br>Mounting Accessories | MA | Visual | 100% | Contract specifications, BOQ. | As per reference documents, Test Report | BHEL Quality Inspection Report. | 3/2 2 | | 1 | |
| 1.3 | Indicating Lamp, Annunciator, Meters, Transducers, Signal Converters, Instruments, Single Loop Controllers | Physical Verification<br>Physical Damages<br>Dimensions<br>Accessories | MA | Visual | 100% | Contract specifications, BOQ. | As per ref documents No physical damage. Test/ Calibration report. | BHEL Quality Inspection Report | 3/2 2 | | 1 | |
| 1.4 | PLC processors, I/O modules, Power Supply modules, Communication modules, Mounting Racks, Ethernet | Physical Inspection<br>• Identification Labels<br>• Physical Damages<br>• Quantity<br>• Spare Capacity | MA | Visual | 100% | Product Catalogue, Data sheets, Approved Configuration diagram, BOQ | As per ref documents. Test Certificates | BHEL Quality Inspection Report. | 3/2 2 | | 1 | |

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

PEM :: C&I

# STANDARD QUALITY PLAN
# FOR
# PROGRAMMABLE LOGIC CONTROLLER

QUALITY PLAN NO.: **PE-QP-999-145-I036___**
VOLUME IIB
SECTION D
REV. NO. 01 DATE: 24.08.2007
SHEET 2 OF 8

| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency $ | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | W | V | |
| 1.5 | CPU, Monitor, Keyboard, Mouse, CD Drives, Printers, OS, System Software, Engineering software in the form of Licensed CD. | Physical Inspection<br>Identification Labels, Tech. Specification<br>Physical Damages<br>Accessories<br>Installation arrangements for Computers & Printers | MA | Visual | 100% | Contract specifications, Product Catalogue, Approved GA / Configuration drawing, BOQ. | As per reference documents. | BHEL Quality Inspection Report. | 3/2 2 | | 1 | |

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency $ | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | W | V | |
| **2.0** | **Assembly** | | | | | | | | | | | |
| 2.1 | Functional Test for HMI/OWS devices such as Monitors, Keyboards, Mouse, Printers etc. | Operation | MA | Functional | 100% | Approved Configuration Diagram & BOQ and FAT | Correct Operation of interconnected Devices of HMI system. | BHEL Quality Inspection Report. | 2 1 | | 1 | |
| 2.2 | Hardware Functional Verification. | Physical arrangement, Wiring check & labeling, Continuity Checking, IR & HV test | MA | Visual/ Electrical | 100% | Approved GA Drawing, Panel Wiring Diagram, IR & HV as per relevant International standard | Test Certification | BHEL Quality Inspection Report. | 2 2 | | 1 | |
| 2.3 Po | wering Up | Healthiness of all the modules/equipment, associated with Powering of PLC system | MA | Visual /Electrical | 100% | Approved power supply scheme | All equipment to be healthy on power ON | BHEL Quality Inspection Report. | 2 1 | | 1 | |
| 2.4 | Burn in test for PLC modules | Healthiness of PLC modules on Continuous Energisation, Temperature maintenance | MA | Visual/ Electrical | 100% F | AT Procedure | Test certification as per FAT | BHEL Quality Inspection Report. | 2 2 | | 1 | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.
1 - BHEL; 2 - Vendor; 3 - Sub-vendor

| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency $ | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | W | V | |
| **3.0** | **Factory Acceptance Test (FAT)** | | | | | | | | | | | |
| 3.1 | Input Output Functional Verification | I/O configuration, I/O operation | MA | Visual/ Eletrical | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 1 | | 1 | |
| 3.2 | Processor Verification | Processor configuration, Powering up, standby operation ( as applicable) and Loading | MA | Visual | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 1 | | 1 | |
| 3.3 | Power Supply Module Verification | Redundancy Operation | MA | Electrical | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 1 | | 1 | |
| 3.4 | Communication System Verification | Redundancy operation of Communication System, Measurement of Response Time, Communication with third party system | MA | Electrical | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 1 | | 1 | |
| 3.5 | Diagnostic Verification | Self Diagnostic features of PLC system | MA | Visual | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 1 | | 1 | |
| 3.6 | Control Panel/Desk Verification | Operation of PLC driven annunciation system, Mosaic, Push buttons & selector switches, Indicating lamps | MA | Visual | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 1 | | 1 | |
| 3.7 | Software Verification | (i) Control Logics (ii) Engineering Features (iii) HMI Features | MA | Visual | 100% | FAT Procedure | AS per FAT | BHEL Quality Inspection Report. | 2 1 | | 1 | |

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics
$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.
1 - BHEL 2 - Vendor 3 - Sub-vendor

## FACTORY ACCEPTANCE TEST (FAT) PROCEDURE

This document covers procedure to conduct/witness PLC system functional tests in order to demonstrate conformity to purchase specifications and related engineering documents. The test shall be conducted at the system suppliers works. The system supplier shall conduct all functional tests before commencing FAT and test results shall be made available during FAT. Vendor must furnish following relevant drawings, duly approved by BHEL Engineering, for reference during FAT.

a) Technical Specification of PLC.

b) PLC System Configuration

c) General Assembly Drawings.

d) Panel Wiring Diagrams.

e) Bill of Quantity for PLC System.

f) Logic Diagram.

g) HMI Schematics.

h) Input / Output List.

Further the vendor shall furnish applicable product specification, datasheets, catalogues, test-certificates, and internal inspection records to enable FAT. Vendor shall also submit, to the inspecting agency, his standard test procedure, for clauses given below; where vendor's standard practice has been referred.

## APPLICABLE TEST PROCEDURE:

### 1. Input/Output Functional Verification.

Check for correctness of addressing of racks, slots and I/O modules as per applicable PLC configuration diagram. Appropriate signal generators shall be used to simulate Inputs and outputs to check operation and SCAN time. Check online replacement of cards, processors, power supply etc.

### 2. Processor Verification

PLC Configuration drawing to be referred for ascertaining

i) Redundancy

ii) Type (Hot or Cold)

Both the processors are to be checked for healthiness in case of redundant configuration as per vendor's standard practice. In case of hot redundancy, switchover of control from primary processor to standby processor shall be demonstrated for uninterrupted control and data processing as per vendor's standard practice. Switchover shall be witnessed, by manual power off or resetting the Primary CPU or simulating failure of primary processor. Checking should be by witnessing the lighting up of Processor's LEDs as per manufacturer's product standard.
Vendor shall demonstrate, as per Vendor's standard practice, adequate Loading (Spare Capacity) of Processors, as mentioned in contract specs. This shall be done, by simulating worst load operation of fully integrated PLC system.

## 3. Power Supply Module Verification

Check if PSM is in redundant mode as per specification. Check the healthiness of power supply from both the modules' lamp indication/measurement. Simulate failure of one PSM and verify that standby PSM has taken over without any interruption.

## 4. Communication System Verification

Communication system has to be in line with approved PLC Configuration Diagram. Verify that both the communication buses are intact and connected. Communication between PLC processors, I/O rack, OWS etc. is to be checked through simulation of input data. Simulate the bus failure by disconnection of working bus. Check that the communication continues without interruption or loss of data.

Following response times are to be demonstrated as per vendor's standard practice for conformance to contract specifications:

1. Screen update time
2. I/O scan time
3. SOE resolution time
4. Data transfer time with third party system using Communication Protocol as per Contract specification and as per quantum of data as per approved signal exchange list.

## 5. Diagnostic Verification

Product Catalogue/Literature shall be referred for checking of all diagnostic features. Hardware failure to be simulated by removing an I/O

## 6. Control Panel /Desk Verification

i) PLC driven annunc iation system should be checked by alar m signal simulation.

ii) Push Button and sele ctor switch operation should be checked by verification of corresponding change of status of Data Base point.

iii) Indicating lamp / MIMIC should be checked by corresponding Data Base point simulation.

## 7. Software Verification

i). Control Logics:– Software switches, lamps and Analog sources shall be used for simulation of field conditions .Control logics shall be checked for its correct functionality as per approved logic schemes

ii). Engineering features:-
a) Online changing of parameters, set points.
b) Online modification in Control Logic Diagrams.
c) Online configuration of Graphics, Trends, Logs, HSR.

iii). HMI features:-
Check for configuration & ope ration of Graphics, Trends, Logs, HSR and Alarms, in the for m of Displays and Printouts, by simulation of Inputs as per approved documents.

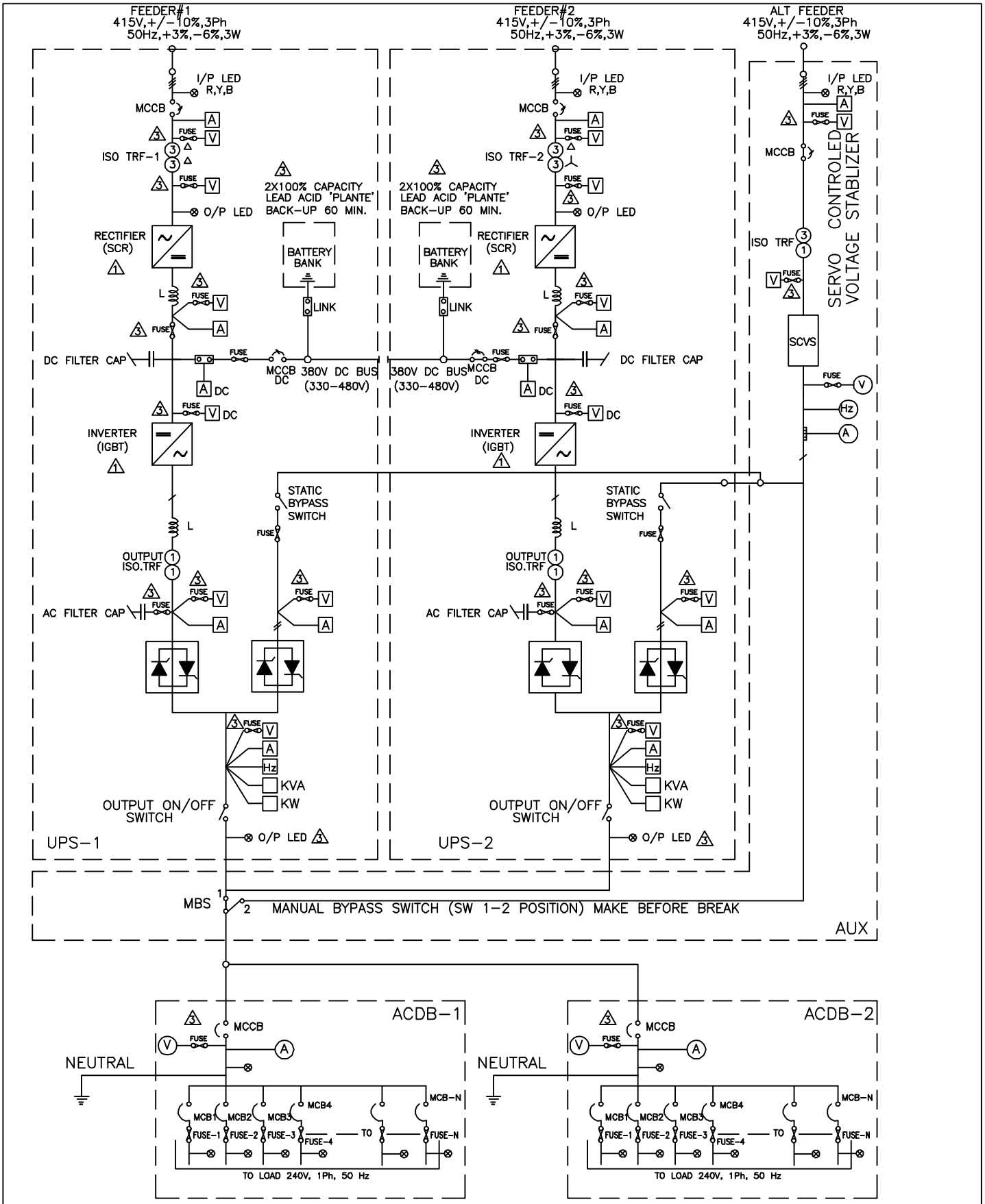
## 8. Burn in Elevated Temperature test

Electronic equipment s shall be subjected to Burn in elevated temperature test as per the procedure detailed below:

a) (i) PLC modules are kept at 50 Deg c under continuous energized condition for 48 hours.

ii) 48 hours test period shall be divided into 4 equal time segment of 12 hours duration each. For every 12 hours duration segment, after lapse of first 11 hours 110% of nominal voltage shall be applied to the panel under test for a period of 30 minutes followed by application of 90% of nominal voltage for the next 30 minutes.

b) Assembled Panels with complete wiring shall be kept under continuous energized condition for 120 hours at ambient temperature. Temperature rise in panels should be below 10 Deg C above ambient.




| | | | | |
|---|---|---|---|---|
| BHEL | 5X800 MW YADADRI TPS, NALGONDA | DRG. No. | PE−DM−417−145−I900 | |
| | TITLE:− UPS SINGLE LINE DIAGRAM | REV. No. | 03 | DATE 19.06.2020 |
| | | SHEET | 7 OF 9 | |

L1

NOTES:

1. ACDB–1&2 NEUTRAL TO BE GROUNDED TO A DEDICATED GROUND.
2. ALL OUTPUT FEEDERS OF ACDB SHALL BE PROVIDED WITH AN LED AFTER THE FUSE FOR FEEDER ON INDICATION WITH FEEDER DESCRIPTION.
3. REDUNDANT FEEDERS SHALL BE LOCATED IN DIFFERENT ACDBs.
4. SINCE, THIS DIAGRAM IS AN SLD FOR UPS, DETAILS REGARDING SIZING HAVE NOT BEEN SHOWN. BHEL–EDN SHALL DO THE SIZING AND PREPARE TECHNICAL SPECIFICATION FOR PROCURING THE UPS.
5. THE FOLLOWING LIST OF ESSENTIAL SIGNAL EXCHANGE BETWEEN UPS TO DCS OR PLC SHALL BE BOTH HARD WIRED (4–20MA) AND THROUGH THE SOFT SIGNALS (RS–485). 2

   A. UPS MAIN INPUT VOLTAGE AND CURRENT
   B. CHARGER OUTPUT VOLTAGE 1
   C. BATTERY CHARGING AND DISCHARGING CURRENT
   D. INVERTER OUTPUT VOLTAGE AND CURRENT
   E. ACDB OUTPUT VOLTAGE AND CURRENT
   F. INVERTER OUTPUT POWER FACTOR
   G. SCVS O/P VOLTAGE, CURRENT.
   H. AFTER LINE TRANSFORMER–1&2 VOLTAGES.
   I. DC VOLTAGE, & CURRENT
   J. STATIC SWITCH MAIN I/P , ALTERNATE I/P VOLTAGE
   K. UPS–1&2 –KVA,KW O/PS.
   L. UPS–1&2 POWER FACTOR, SYSTEM& GRID FREQUENCY.
   M. EMERGENCY AC SUPPLY VOLTAGE & CURRENT.

   ALL THE UPS INPUTS/OUTPUTS SIGNALS SHALL BE INDICATED IN I/O LISTR

6. IGBT'S WILL BE PROVIDED IN INVERTER CIRCUIT AND SCR'S WILL BE PROVIDED IN RECTIFIER CIRCUIT. 1
7. POTENTIAL FREE CONTACTS SHALL BE GENERATED AND USED IN DCS FOR UPS FAULTS AS LISTED BELOW 2

   1)MCS FUSE FAILURE(RYB)
   2)RECTIFIER FUSE FAILURE
   3)DC BREAKER ON /OFF
   4)INVERTER SAT TRIP
   5)INVERTER OUTPUT VOLTAGE LOW
   6)DC INPUT VOLTAGE LOW TO ACDB
   7)STATIC SWITCH IS ON ALTERNATE INPUT
   8)ALTERNATE INPUT FUSE FAILURE
   9)INVERTER OVER LOAD.

8. MCB/FUSE SHALL BE PROVIDED AT EACH LOCATION OF VOLTMETER. 2
9. MCB/FUSE SHALL BE PROVIDED AT AC FILTER CAPACITOR. 2
10. INDICATING LAMP AFTER EACH OF THE UPS 1 & 2 OUTPUT ON/OFF SWITCH SHALL BE PROVIDED 2

| | | | | | |
|---|---|---|---|---|---|
| BHEL | 5X800 MW YADADRI TPS, NALGONDA | DRG. No. | PE–DM–417–145–I900 | | |
| | TITLE:– UPS SINGLE LINE DIAGRAM | REV. No. | 03 | DATE | 19.06.2020 |
| | | SHEET | 8 | OF | 9 |

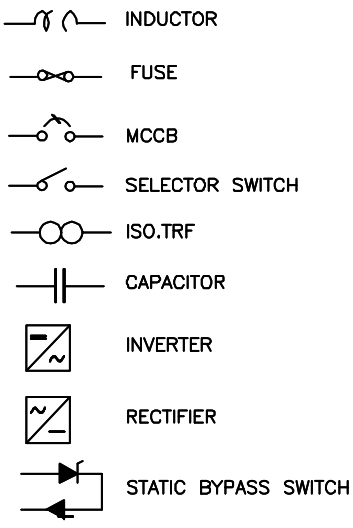
11. ALARM ANNUNCIATION SHALL BE AVAILABLE FOR FOLLOWING FAULTS:

A. SYSTEM FAULT
B. RECTIFIER CHARGER FAILURE
C. INVERTER FAILURE /FAULTY
D. BATTERY UNDER VOLTAGE
E. UPS OVER TEMPERATURE
F. OVER LOAD
G. STATIC TRANSFER TO STAND-BY
H. TRANSFER INHIBTED
I. OVER LOAD SHUTDOWN
J. EMERGENCY SHUTDOWN
K. BATTERY CIRCUIT BREAKER / SWITCH OPEN
L. AC MAIN FAILURE
M. AC STAND-BY SOURCE MAINS FAILURE
N. MANUAL BYPASS ON
O. FAN FAILURE
P. ASYNCHRONOUS CONDITION
Q. CONTROL POWER FAILURE.

12. FOLLOWING STATUS INDICATION SHALL BE AVAILABLE ON MIMIC IN THE PANEL . CONTACTS OF THESE SHALL BE AVAILABLE AND MADE USE FOR STATUS INDICATION IN DCS:

A. MAINS ON
B. RECTIFIER ON
C. BATTERY ON LOAD
D. INVERTER ON
E. AC STAND-BY SOURCE ON
F. INVERTER ON -LOAD
G. MANUAL BY-PASS ON
H. LOAD ON STATIC BY PASS.

## LEGEND:

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| BHEL | 5X800 MW YADADRI TPS, NALGONDA | DRG. No. | PE-DM-417-145-I900 | |
| | TITLE:- UPS SINGLE LINE DIAGRAM | REV. No. | 03 | DATE 19.06.2020 |
| | | SHEET | 9 OF 9 | |

# TECHNICAL SPECIFICATION
# FOR
# UNINTERRUPTIBLE POWER SUPPLY

## CONTENT



## ATTACHMENTS

**SECTION-XIV**

**TECHNICAL SPECIFICATION**
**FOR**
**UNINTERRUPTIBLE POWER SUPPLY**

## 1.00.00 SCOPE OF WORK

### 1.01.00 Scope of Supply

The scope of supply shall include Uninterruptible Power Supply (UPS) Systems with parallel redundant arrangement as specified below for Main Plant, 400kV Switchyard control room, CHP control room with PLC system & associated RIOs and other PLC based control systems of off-site packages specified elsewhere in the specification.

Two (2) sets of UPS in Main Plant, out of which one (1) set for main TG, SG,Station, C&I etc of MAIN PLANT systems, 2nd set for common DDCMIS/PLC systems for the PLC/DCS systems of air compressor, online tube cleaning system, HVAC system, fire detection panel in CCR, which are in TG building & OWS systems of Plant Water System, AHP,CHP etc systems ( which are placed in CCR common control desk)

i) Each set of UPS system will consist of :

   a. 2x100% capacity static inverter & input isolation transformer

   b. 100 % capacity static switches (2 nos.)

   c. One manual bypass switch

   d. 2x100% capacity float-cum-boost chargers

   e. 2x100% capacity UPS system battery (Lead Acid Plante Type) with back up time of 1 hour.

   f. One step down transformer; (415 V three phase to 240 V single phase) for bypass

   g. One static voltage regulator

   h. Two AC distribution boards (ACDB-1A and ACDB-1B)

   i. Interconnecting cable between UPS Equipment, battery and ACDB.

   j. Two (2) nos. input output isolation transformer

   Any other equipment necessary for complete of the system

ii) One (1) set of special tools and tackle.

iii) Mandatory Spare parts.

iv) All relevant drawings, data and instruction manuals.

## 2.00.00 CODES AND STANDARDS

a) All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.

b) Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

c) The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules or regulations applicable to the work shall be followed.

## 3.00.00 DESIGN CRITERIA

### 3.01.00 Design Basis

a) UPS System provides a regulated and uninterrupted single phase A.C. power, within specified tolerances, to critical station loads during normal and emergency operation. Capacity of inverter output shall be computed by the contractor considering the above requirement. 25% spare margin shall be kept on the total of above requirement.

b) The UPS system excluding its battery shall be installed indoors in A.C. environment.

c) UPS shall be worked at its full capacity even battery is not connected with the system.

d) UPS system shall be compatible for satisfactory and well-coordinated operation with other related equipment as well as with input and output systems.

e) Energizing or de-energizing any portion of the system serviced by the UPS shall not cause output changes which will affect the operation or integrity of the remaining portions of the system in any way.

f) The equipment shall be self-protecting against all A.C. and D.C. transients, voltage surges and steady state abnormal voltages and currents.

g) The circuit protection shall be coordinated with UPS short circuit capacity and protective device characteristics so that a fault on any circuit shall result in minimum loss of function.

h) All non-interrupting components of UPS system shall be capable of withstanding the prevailing short circuit current without damage.

i) All circuit interrupting components shall be capable of withstanding and interrupting the prevailing short circuit currents without damage.

j) The procedure for battery sizing calculation shall be generally as per relevant IEEE, considering design margin as 15% and aging factor as 1.25

k) For continuous operation at specified ratings, temperature rise of the various components of UPS system shall be limited to the permissible values stipulated in the relevant standards and/or this specification.

l) The chargers, inverters, static switches, regulating transformers and voltage stabilizers should be arranged in such a way that any equipment can be fully isolated for maintenance without affecting in any way the operation of other panels/components.

m) The chargers, inverters, static switches, regulating transformers and voltage stabilizers should be arranged in such a way that any equipment will be fully isolated for maintenance without affecting in any way the operation of other panels/ components.

n) In the A.C. Distribution Board, the Bidder shall provide 10% or minimum one (1) no. spare feeder of each size and type of the outgoing feeders.

o) All the cooling fans inside the panels shall be of industrial grade only.

3.02.00 **System Concept**

System Concept

a) A.C. power source are available to the UPS system. The system is so designed that its load shall be served without interruption as long as one of the above power sources is available within specified limit of voltage and/or frequency.

The UPS will consist of two physically separate sets of equipment streams each consisting of the following:

i) One set of converter to convert incoming 240V, 1 Ph, 50 Hz A.C. power to suitable D.C.

ii) One set of suitable Battery Bank to get charged by the above referred converter and to feed the inverter described below.

iii) The Float-cum-Boost charger will be normally ON, supplying the DC load current and at the same time trickle charging the battery. The characteristics shall be such that if load is high and exceeds the charger capacity, the excess load shall be supplied by the battery.

iv) The Float-cum-Boost charger shall be provided with Solid State electronic regulators to prevent rising of charging current to avoid thermal runaway of the batteries.

v) The float-cum-boost charger shall also have provision for float, equalizing and boost charging the battery through manual selection.

vi) Output of the chargers shall be controlled automatically as well as manually. AUTO/MANUAL selector switch along with voltage/current setter shall be provided for this purpose.

vii) For ungrounded DC system, suitable ground fault detection system shall be provided in the battery charger panel to detect ground fault on either polarity for annunciation in charger panel.

viii) The batteries shall be so sized as to meet emergency load duty cycle requirements for one (1) hour as referred in Annexure-A. All momentary loads shall be treated as one-minute loads.

ix) One set of inverter to take D.C. input from above referred converter - Battery assembly output and to produce high quality 240V, 1Ph 50 Hz A.C. output power.

x) One set of standby bypass stream consisting of suitable transformer, voltage stabilizer etc. to produce regulated 240V, 1 Ph. 50 Hz A.C. power from new input 240V, 1 Ph. 50 Hz A.C. power.

xi) One set of static switch, synchronizing circuit to parallel the above-mentioned Inverter output and bypass stabilized raw power stream.

xii) One UPS A.C. power distribution board with suitable no. of output feeders.

Two sets of equipment streams as mentioned above will constitute the UPS system.

One set of synchronizing equipment and high performance static switch will parallel the above two streams and common output will be taken to loads which can accept only single non-redundant power input source.

For equipment requiring dual redundant input power source, separate cables will be taken from the individual UPS Power Distribution Boards of the above-mentioned two UPS streams.

The system will ensure highest system availability around 99%.

b) Each of the two UPS streams will be of 100% capacity and will normally work, each sharing 50% load. On failure of any stream, its load gets automatically transferred to the other inverter through static transfer switch.

c) If one UPS stream is out of service for any reason then the second UPS stream will be working with 100% UPS load.

d) Inside each stream on failure of its converter/battery/inverter assembly the standby A.C. source will back up to supply the 100% UPS load automatically through static transfer switch.

3.03.00 **Layout Criteria**

The UPS system will be located indoor.

The Contractor shall indicate the space requirement for the equipment offered by them separately for UPS cabinet, UPS battery and UPS distribution board.

Battery room ventilation shall be under the scope of the Contractor.

4.00.00 **SPECIFIC REQUIREMENTS**

4.01.00 **Static Inverter**

a) The static inverters shall be static type consisting of IGBT PWM type inverter, static filters, integrated control modules including necessary oscillators, voltage regulators, current limiting and surge suppression.

b) The inverter equipment shall include all necessary circuitry and devices to conform requirements like voltage regulation, soft start, transient recovery, protection, automatic synchronisation, wave shaping, etc. as specified herein.

c) Upon transfer of full load, the inverter output voltage shall not drop below 80% of nominal voltage during the first half cycle after transfer and 90% of nominal voltage in the next half cycle. The recovery to within $\pm$ 2% of voltage shall be in less than 50 milli-seconds.

d) On occurrence of a fault in branch circuit, the inverter shall be capable of clearing the highest rated branch circuit fuse in 4 milli-seconds or less.

e) The inverter shall be protected against overload, short circuit, 100% loss of load, as well as excursions, loss or restoration of D.C. input voltage and synchronising voltage. The overload capacity shall be 125% for 10 mins., 150% for 60 secs. and 300% for 4 msecs.

f) The D.C. input current shall never exceed twice the full load current except for a short circuit within the inverter.

g) For any value of the load and load power factor drawn by the equipment served, the inverter shall not impose on D.C. source any voltage oscillations in excess of 5 volts (RMS total all frequencies) or any current oscillations in excess of 3 percent (RMS total all frequencies) of the D.C. current at full load.

h) The inverter will be self protecting against A.C. and D.C. Transients, voltage surges and steady state abnormal voltage and currents likely to be encountered in the plant.

4.02.00 **Automatic Synchronisation**

a) Inverter equipment shall include stable solid state oscillator devices designed to automatically maintain the inverter output in phase and in synchronism with the stand-by A.C. source.

b) Facility shall be provided for automatic transfer to internal oscillator operation when the stand-by source frequency is beyond specified limits and the frequency shall be automatically controlled within 50 Hz plus or minus 0.5 Hz when the inverter operates in this mode.

c) Retransfer to stand-by A.C. source for synchronisation shall be automatic after the stand-by source frequency is restored to permissible limits and remains within this limit for an adjustable time delay period (up to 5 seconds).

d) Provision shall be made for stepless adjustment of synch- disconnect frequency range from 50 Hz $\pm$ 0.5 Hz to 50 Hz $\pm$ 2 Hz.

e) Automatic adjustment of phase relationship between inverter output and stand-by A.C. source shall be gradual at a controlled slow rate, which shall not exceed one hertz per second.

4.03.00 **Static Transfer Switch**

a) The static transfer switch shall be solid-state type using SCR for automatic/manual transfer of load from "inverter" to "stand-by" source and vice-versa.

b) Stand-by source can be either of the inverter or A.C. source depending on whether both the inverters are supplying 50% load each or one of the inverter is carrying 100% load.

c) The transfer time including sensing shall not be more than one-fourth cycle. Further the transition shall be make-before-break in both directions.

d) The capacity of static transfer switch shall be equal to the continuous full-load capacity of the inverter. The switch shall be provided with protective devices in both normal and alternate power source.

e) Static transfer switch shall be furnished with contact to alarm failure of the alternate source or opening of any fuse protecting the static switch.

f) Static transfer switch shall include all necessary circuitry and devices to meet the functional requirements of transfer initiation, transfer inhibit and re-transfer back to normal as detailed below

g) Transfer Initiation

i) The transfer of static switch from normal 'Inverter' position to 'stand-by' position shall be initiated by one of the following causes.

- Inverter failure and UPS system trouble
- Inverter output voltage failure.
- Manual push button operation

ii) The UPS bus shall be monitored by two voltage detectors. One fast acting circuit shall be used for detecting a complete and instantaneous voltage loss while the other slower acting averaging circuit with adjustable trip level shall be employed to detect voltage deviation beyond selected limits. Both voltage detector circuits shall automatically initiate operation of transfer switch.

iii) The static switch shall automatic transfer the load from inverter to stand-by source when the maximum $I^2t$ capability of the inverter is reached and when the inverter output drops below 90%.

h) Transfer Inhibit

Automatic or manual transfer from inverter to stand-by A.C. source vice versa shall be inhibited when the inverter frequency is not synchronised to the alternate source.

i) Retransfer to Normal

1) The return to inverter mode shall be manual in all cases.

2) Manual transfer shall be initiated by push button actuation.

4.04.00 **Manual By-pass Switch**

a) Manual by-pass switch is used to isolate any static transfer switch for maintenance or repair without interruption to the UPS load.

b) The switch has also the facility of by-passing both the static transfer switches during start-up at the option of the operator.

c) Switch contact shall be make-before-break type.

d) The switch shall have current rating equal to the full load inverter current and necessary short time load carrying and interrupting capacity to meet the requirement of UPS system.

4.05.00 **Battery**

a) General

i. Each set of battery shall consist of number of cells assembled together on mounting racks.

ii. The battery shall be flooded cell Lead acid PLANTE type and shall be suitable for operating satisfactorily in humid and corrosive atmosphere. The batteries will be suitable for float /boost charging and will be suitable for continuous operation.

iii. The equipment shall comply with the requirement of latest revision of Indian standards issued by BIS (Bureau of Indian Standards): IS: 1652:1991 and IEEE Std. 485 for Lead Acid (Plante) Battery.

In case Indian Standards are not available for any equipment, Standards issued by IEC/BS/VDE/IEEE/NEMA or equivalent shall be applicable.

iv. Autofill system

Bidder to provide complete system for automatic water filling (topping-up) of lead acid plante' type batteries to avoid spillage of water and acid which spoils environment. The autofill system shall be intelligent and efficient where replenishment of water is done automatically without manual intervention. The water enters the cell through the 'autofil plug' and raises the electrolyte to a preset level controlled by the float. The float raises and closes the valve in the plug by a 2.5:1 level action. When the electrolyte level drops the float operated valve will open automatically Bidder to provide the total system including necessary storage tank, pipelines, autofill plugs and all peripherals etc. The material of all parts shall be acid proof plastic material.

b) Technical Requirement

i) The battery shall be heavy duty type suitable for power plant duty with float duty operation at constant voltage permanently applied to its terminals which is sufficient to maintain the limits of +10% and -15% of the nominal system voltage at any time during the duty cycle in state close to full charge and shall be designed to supply the load in the event of normal power supply failure.

ii) The rated ampere hour capacity of the cell/battery shall be at reference temperature of 27ºC, constant current discharge at 10 hours rate (C10) for Plante type Battery to meet end cell voltage of the Cell. A design margin of 20% shall be considered.

iii) The battery shall be suitable for being boost charged to fully charged condition from fully discharged condition within eight (8) hours.

iv) The batteries shall be so sized as to meet emergency load duty cycle requirements for one (1) hour. All momentary loads shall be treated as one-minute loads.

v) For PLANTE type Battery it shall be supplied uncharged for flooded cell with the electrolyte furnished in a separate non-returnable container. 10% extra electrolyte shall be furnished to cover spillage in transit or during erection.

vi) Each battery set shall consist of a group of cell electrically connected in series to attend the nominal voltage level specified on the data sheet. The terminal cells shall be supplied with connectors for termination to the charger. The supplier shall provide inter-cell connectors and related hardware and accessories required for normal operation and maintenance. All cell posts shall be shrouded and connectors insulated. Nickel plated copper shall be furnished to connect up cells of Battery set. For lead acid battery to prevent corrosion all copper/ brass material shall be effectively coated with lead.

vii) Cell container shall be made of heat resistant, tough translucent polypropylene (SAN) material to make the cell mechanically sturdy and facilitate visual electrolyte level checks for ease in of maintenance.

viii) The cell terminals posts shall be provided with connector bolts and nuts, made of Nickel plated steel or lead coated copper/brass material to prevent corrosion. The terminals shall be suitable for short circuit current and specified discharge current without damage to cell as a result of terminal heating.

ix) Flame arresting flip-open/ or ceramic vent cap shall be provided on the cell to avoid explosion and contamination.

x) The following information shall be permanently marked on the cell :

- Nominal voltage.
- Name or manufacturer/model reference.
- Rated capacity in ampere hour (Ah) with End Cell Voltage.
- Voltage for float operation of 27° with tolerance of ±1%.
- Month and year of manufacture.

xi) Battery racks shall be constructed of best quality teakwood with at least three (3) coats of electrolyte -resistant paint of approved shade forming a rigid structure. Cell shall be supported on PVC/porcelain/Hard Rubber insulator fixed on the rack with adequate clearance between adjacent cells.

xii) Each set of battery shall be equipped with a automatic battery condition (Health check) and performance monitoring system. The battery monitoring system shall compare measured figure during a partial discharge against stored characteristics for the type and capacity of the battery. The system shall be able to test, analyse and predict the battery performance, computing remaining capacity and battery efficiency. The automatic battery monitoring system shall compensate for cell temperature and discharge load current throughout the discharge cycle, premature failure of the batteries etc. The system shall have a programmable event log shall be secured in

the event of total power failure for a period upto six month. In addition to local indication and control the battery monitoring system shall include an RS. 232 output port to enable battery parameters and alarms to be monitored from plant DCS

4.06.00 **Float-cum-Boost Charger**

4.06.01 The charger shall be solid-state type with full wave fully controlled, bridge configurations. It shall be suitable for the inverter of IGBT type.

4.06.02 The charger shall be provided with automatic voltage regulation, current limiting, smoothing filter circuit and soft-start feature.

4.06.03 The charger shall have the provision of float, equalizing and boost charging. Further the charger shall be suitable for single and parallel operation.

4.06.04 Suitable circuitry shall be provided to ensure that the charging current is voltage regulated and current limited.

4.06.05 Each charger shall be rated to meet 100% UPS load plus recharge the fully discharged UPS battery within 8 hours.

4.06.06 Voltage control shall be stepless smooth and continuous. Float & equalizing control shall have an adjustable range of ± 5%.

For Other details as given in sub-section of Battery & Battery charger specification

4.07.00 **Step-down transformer and voltage stabilizer**

a) A three phase to single phase transformer along with associated voltage stabilizer shall be furnished with the UPS system.

b) The transformer and stabilizer shall be sized for 100% UPS load and shall coordinate with the largest branch circuit protection device for feeder short circuit current without sacrificing voltage regulation.

c) The voltage stabilizer shall employ silicon solid state circuitry and shall maintain the specified output voltage for 0 to 100% load with maximum input voltage variation as indicated in the annexure.

d) Provision shall be kept for dead closing of static transfer switch from stabilizer circuit to inverter when the output of the stabilizer is zero, but at that time the inverters are running.

4.08.00 **A.C. Distribution Boards**

a) The distribution boards shall be fixed type, of modular design in freestanding gasketted sheet steel enclosure conforming to IP-54. Sheet steel thickness shall be 2 mm minimum.

b) Each module shall be housed in a separate compartment complete with individual front access door. Working height shall be limited to 1800 mm from floor level.

c) A full height vertical cable alley shall be provided in each panel to facilitate module wiring. The alley shall be liberally sized and shall have removable cover at the front. Removable back covers shall be provided at the back of the panels.

d) Switches shall be double pole, air break, heavy duty type, capable of safely making and breaking the full load current of associate circuit.

e) Switch handle shall have position indicator and provision of padlocking in ON & OFF positions. Further it shall be interlocked with access door for safety.

f) Fuses shall be HRC, preferably link type, design to permit easy & safe replacement.

Visible indication shall be provided for indication of fuse.

4.09.00 **UPS Cabinets/Enclosures**

a) The UPS system components shall be housed in a sheet steel freestanding IP-42 enclosure with all access from the front. Sheet steel thickness shall be 2 mm minimum.

b) The enclosure shall consist of vertical cabinets housing modules in rack type sub-assemblies, connected mechanically and electrically to form a rigid, self-supporting, metal enclosed structure.

c) The modular units shall be mounted in pull out and/or swing trays. Each module shall be capable of being easily removed to provide for the ready inspection of major solid-state devices.

d) Vertical wiring trough shall be provided for the entire height of the UPS cabinet. Cable entry shall be from bottom only.

e) Adequate ventilating louvers and screens shall be provided. The top of the panel shall be protected by a suitable drip cover to prevent entrance of falling liquid and foreign material.

f) If the equipment supplied requires forced air cooling, the cooling system furnished shall meet the following requirement :

i) Two (2) nos. 100% cooling fans, industrial grade, shall be provided for each vertical panel.

ii) Completely independent duplicate protection, control and wiring systems shall be provided for the cooling fans for redundancy.

iii) The cooling fans shall be powered from the output of the associated inverter. Normally one fan will be running while the other is on stand-by.

iv) Each cooling fan shall be equipped with an airflow switch having an alarm contact that closes upon failure of airflow.

4.10.00 **Alarms**

a) Solid state audio-visual annunciation system shall be provided for inverters, static transfer switch, battery charger.

b) Alarm facia shall be provided on each charger and inverter panel, complete with proper actuating devices, circuitry and legends.

c) The arrangement shall be such that on occurrence of a fault the corresponding window will light up and stays lighted until the fault is cleared and reset button pressed.

d) Each time a window lights up a master relay will get energized to provide group alarm signals for remote DDCMIS alarm system.

e) The requirements of indication/metering/alarms are given in the annexure.

f) Alarm contacts shall be rated 0.5 A at 220 V DC and 5A at 240 V A.C.

g) All indicating meter shall be digital type with in-built transducers (4-20mA) for hooking up with DDCMIS.

4.11.00 **Lamp / Space Heaters / Receptacles**

a) The panels shall be provided with :

i) Internal illumination lamp with door switch.

ii) Space heater with thermostat control.

iii) 3-pin 6A receptacle with plug.

b) Lamp, heater and receptacle circuits shall have individual switch fuse units.

4.12.00 **Wiring / Cabling**

a) The panels shall be completely wired up. All wiring shall be done with flexible, 1100V grade, fire resistance PVC insulated wires with stranded 2.5 Sq.mm. copper conductors and routed through wiring troughs. Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal block No., terminal number as per approved wiring diagram.

b) Panels shall have removable gland plate for cable entry. All incoming/ outgoing cables shall be terminated in suitable terminal block.

c) Control terminal blocks shall be box-clamp type, minimum 10 Sq.mm. 20% spare terminals shall be furnished.

4.13.00 **Nameplate**

a) Engraved nameplates shall be provided for each panel and for each equipment/device mounted on it.

b) The material shall be anodised aluminium / lamicoid, 3 mm thick, with white letters on black background.

c) Nameplates shall be held by self-tapping screws. The size of nameplates shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for panels.

d) Nameplates for panels shall be provided both on the front and rear.

e) Control and meter selection switches shall have integral nameplates. Nameplates for all other devices shall be located below the respective devices.

f) Instruments and devices mounted on the face of the panels shall also be identified on the rear with the instrument/device number. The number may be painted on or adjacent to the instrument or device case.

g) Caution notice on suitable metal plate shall be affixed at the back of each panel.

4.14.00 **Grounding**

a) Normal 3-phase A.C power supply will be grounded at the source. For grounding other than this, isolation transformer shall be furnished with the U.P.S.

b) The inverter D.C. input and A.C. output shall be electrically isolated from each other and from cabinet ground.

c) Panels shall have fully rated ground bus with two ground terminals, one at each end.

d) Each terminal shall comprise two-bolt drilling M10 G.I. bolts and nuts to receive ground connection of 50 x 6 mm G.S. flat.

e) Separate electronic grounding shall be provided for each UPS system.

4.15.00 **Tropical protection**

a) All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus insects and corrosion.

b) Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

4.16.00 **Painting**

Finish paint shall be as per TSGENCO practice. Refer to clause no.1.16.00 of Section-I, Volume V-A.

5.00.00 **TESTS**

5.01.00 **Shop Tests**

5.01.01 Tests on Battery

a) Test for capacity - test for voltage during discharge

b) Ampere hour & watt hour efficiency test

c) Endurance test.

5.01.02 Tests on battery charger

a) Dielectric tests.

b) Voltage regulation check from 0 to 100% load with ± 10% input voltage variation.

c) Ripple content measurement.

d) Heat run test on current limiting value.

5.01.03 Tests on UPS System

a) Type & routine test for various components.

b) Burning test on PCBS - Assembled PCBS shall be tested at 70°C for 72 hours in loaded condition.

c) Rapid temperature cycling test at 70°C and 0°C for 30 minutes at each temperature - 5 such cycles.

d) Functional tests to demonstrate compliance with all specified requirements and published. Specifications such as frequency, regulation, voltage regulation, current limiting, fuse clearing capability of inverters, demonstration of phase and frequency control of inverter for synchronization with range of adjustments transfer and retransfer of static switches under influence of under voltage and over current, tests on chargers, batteries and other system component to confirm compliance with specification.

6.00.00 **DRAWINGS, DATA & MANUALS**

6.01.00 **To be submitted with the Bid**

6.01.01 UPS panels, Battery Charger and Battery layout drawing with dimensions

6.01.02 General Arrangement drawing of UPS panels

6.01.03 Bill of Material

6.01.04 Schematic drawing of UPS circuits

6.01.05 Battery cell voltage characteristics and data for different discharge rates

6.01.06 Technical leaflets on :

a) UPS System

b) Battery

c) Battery charger

d) Inverter

e) Static Switch

f) Manual bypass Switch

6.01.07 Duty cycle diagram and battery sizing calculation in the format of relevant IS Standard

6.01.08 Sizing calculation of UPS system, charger main equipment, viz. SCRs, rectifier transformers etc

6.01.09 Type test certificates for similar equipment.

6.02.00 To be submitted for Owner's Approval and Distribution
All relevant drawings and data pertaining to the equipment like GTP, GA drawing, BOM, foundation plan, schematic drawing, QAP, sizing calculations, etc shall be submitted by the Bidder for the approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

## ANNEXURE-A

## RATINGS & REQUIREMENTS

| | | | |
|---|---|---|---|
| 1.00.00 | STATIC INVERTER | | |
| 1.01.00 | Application | : | UPS System for Control system, DCS and other loads as required by Bidder. |
| 1.02.00 | Type | : | Static IGBT PWM type |
| 1.03.00 | Duty | : | Continuous |
| 1.04.00 | Enclosure | : | Sheet steel, IP42 |
| 1.05.00 | Cooling | : | Natural convection or forced cooling using redundant fans. |
| 1.06.00 | Design Ambient temperature | : | 50 Deg.C |
| 1.07.00 | Inverter capacity | : | To be decided by the Bidder |
| 1.08.00 | Overload capacity | : | 300% for 4 m secs.<br>150% for 60 secs<br>125% for 10 mins<br>110% for continuous |
| 1.09.00 | Voltage | | |
| | a) Inverter input, Battery output | : | To be decided by the Bidder |
| | b) Nominal output | : | 240 V, 50 Hz, 1-phase |
| 1.10.00 | Voltage Regulation : | | |
| | a) Steady state (0-100% load at all input voltages and all power factors) | : | $\pm$ 1.5% |
| | b) Transient voltage (On application or removal of 100% load) | : | $\pm$ 10% |
| | c) Time to recover from transient to normal voltage | : | 50 milliseconds. |

1.11.00 Wave form :

| | | | |
|---|---|---|---|
| a) | Nominal frequency | : | 50 Hz |
| b) | Frequency range for all conditions of input supplies, loads & temperature occurring simultaneous or in any combination (automatically controlled) | : | $\pm$ 0.05 Hz. |
| c) | Synchronisation limits (for maintenance of synchronism between inverter and standby A.C source) | : | 49 Hz to 51 Hz (factory set) |
| d) | Field adjustment range for (c) above | : | 50$\pm$ 0.05 Hz to 50$\pm$ 2 Hz |
| e) | Total Harmonic Content | : | 5% maximum at rated load |
| f) | Harmonic content for any single harmonic | : | 3% maximum |

1.12.00 Rated output current at rated output voltage with current limit not operating

| | | | |
|---|---|---|---|
| a) | Current | : | 200% |
| b) | Duration | : | 100 milliseconds. |

1.13.00 Efficiency at full load (Watt output/watt input) : 90% or better.

1.14.00 SCR derating from peak voltage and peak rating : 50%

2.00.00 STATIC SWITCH

2.01.00 Type : Solid-state, SCR

2.02.00 Duty : Continuous

2.03.00 Enclosure : Sheet Steel, IP42

2.04.00 Cooling : Natural convection or forced cooling using redundant fans.

2.05.00 Ambient Temperature : 50 Deg.C

2.06.00 Capacity

a) Continuous : Equal to full load capacity of the inverter.

| | | | |
|---|---|---|---|
| | b) Overload | : | 300% for 4 m secs.<br>150% for 60 secs<br>125% for 10 mins<br>110% for continuous |
| | c) Peak | : | 1000% of continuous rating for 5 cycle. |
| 2.07.00 | Normal Voltage | : | 240V, 50 Hz, 1-phase. |
| 2.08.00 | Transient Voltage Tolerance | : | 340V peak above the nominal line voltage. |
| 2.09.00 | Transfer Time | : | less than 4 m secs. |
| 3.00.00 | MANUAL BY-PASS SWITCH/BREAKER | | |
| 3.01.00 | Type | : | Maintained, make before break. |
| 3.02.00 | Voltage | : | 600V |
| 3.03.00 | Rated Current | : | To meet the system requirement |
| 4.00.00 | BATTERY | | |
| 4.01.00 | Application | : | UPS Battery |
| 4.02.00 | Design Ambient Temperature | : | 50 Deg.C |
| 4.03.00 | Type | : | Lead Acid Plante type |
| 4.04.00 | Nos. of Cells per Battery | : | To be decided by the Bidder |
| 4.05.00 | Battery nominal voltage | : | To be decided by the Bidder |
| 4.06.00 | Battery AH rating | : | Bidder to compute considering 100% UPS load for 30 minutes followed by 60% UPS load for 30 minutes. |
| 4.07.00 | Method of working | | |
| | a) Float charge (Normal) | : | 2.23 Volts / Cell |
| | b) Boost charge (After complete discharge) | : | 2.30 Volts / Cell |
| | c) End cell voltage | : | 1.80 Volts |
| 4.08.00 | Mounting | : | Steel Rack |
| 4.09.00 | Connection | : | Cables |

| | | | |
|---|---|---|---|
| 5.00.00 | BATTERY CHARGER | | |
| 5.01.00 | Charger | : | Float + Boost |
| 5.02.00 | Type | : | Solid-state, full wave, fully controlled. |
| 5.03.00 | Duty | : | Continuous |
| 5.04.00 | Enclosure | : | Sheet Steel, IP42 |
| 5.05.00 | Cooling | : | Natural convection or forced cooling using redundant fans. |
| 5.06.00 | Design Ambient Temperature | : | 50 Deg.C |
| 5.07.00 | A.C. input : | | |
| | a) Supply | : | 415V, 3-phase, 50 Hz |
| | b) Voltage variation | : | ±10% |
| | c) Frequency variation | : | +3% to -5% |
| | d) Combined volt frequency variation | : | 10% (absolute sum) |
| | e) Short-circuit level | : | 50 KA |
| | f) System earthing | : | Solidly grounded |
| 5.08.00 | D.C. output | : | 100% UPS load plus restoring fully discharged battery to full charge condition in 8 hours. |
| 5.09.00 | Blocking Diode, Peak inverse voltage | : | 800 V (minimum) |

5.10.00 Performance Requirement

a) The output voltage of the charger shall be regulated within ± 1% of the set value for any load variation from 0 to 100% and A.C input voltage and frequency variation as indicated above in 4.06.00

b) The ripple content in charger D.C. output shall be limited to less than ± 1% with battery and less than ± 2% without battery.

| | | | |
|---|---|---|---|
| 6.00.00 | DISTRIBUTION BOARDS | | |
| 6.01.00 | Type | : | Fixed, Modular. |
| 6.02.00 | Enclosure | : | Sheet Steel, IP54 |
| 6.03.00 | Mounting | : | Free standing<br>(can be attended from both front & back) |

## ANNEXURE-B

## SET OF ACCESSORIES TO BE PROVIDED FOR EACH BATTERY BANK

a) One battery log book.

b) Two copies of printed instruction sheet.

c) One no. cell testing voltmeter (3-0-3 volts) complete with leads.

d) One no. rubber syringe type hydrometer suitable for specific gravity reading.

e) Three nos. pocket thermometer.

f) One no. thermometer (0 to 100°) with specific gravity correction scale.

g) One set cell bridging connector.

h) Battery racks suitable for accommodating the cells coated with paint.

i) Delrin insulator (with 5% extra), rubber pad etc. for rack.

j) Two nos. plastic filling bottle for filling up.

k) One pair of spanners.

l) Two pairs of rubber hand gloves.

m) Two nos. cell lifting straps.

n) One set of inter cell, inter tie and inter bank connectors as required for complete installation.

o) One cell charger for each set of battery bank (of AH capacity)

o) Apron.

p) Goggles.

q) 'No Smoking' Notice Board

**NOTE:** Any other accessories if required for satisfactory operation of the complete battery system shall also be included under the Scope of Contractor without any price implication.

## ANNEXURE-C

**TENTATIVE LIST OF LOADS/LOAD CENTERS**:

Bidder shall provide UPS supply to the following panels/ instruments. The list is just indicative and not exhaustive. Exact sizing of UPS is of Bidder's responsibility and shall be finalized during detail engineering. The bidder has to design/calculate the same during detailed engineering stage subjected to owner's approval.

i) Vibration Monitoring Panel

ii) Acoustic Tube Leak detection Panel

iii) Gravimetric Feeder Control Panel

iv) SWAS Panel

v) Conductivity type level transmitter for Boiler drum & HP heaters

vi) Flame Monitoring Panel

vii) CCTV System

viii) Flue gas analysers

ix) $O_2$ Measurement systems

x) Stack Opacity Monitoring System

xi) $H_2$ Purity meter & Moisture measurement system

xii) Stator water conductivity monitoring system

xiii) Mass Flow transmitters

xiv) All PLCs and control systems (non DCS) within Power House building.

xv) Electrical/Unit Control Panels including DAVR panel

xvi) One source to all DCS Panel

xvii) DCS network peripherals.

xviii) Dual (one source from each separate units) Control Supply for local Electrical Compressor panels.

xix) ASLD Panel, EWLI

xx) Bunker level monitoring system,

xxi) Switchyard Control Room

xxii) CMMIS System

UPS source in the central control room shall be extended to all network peripherals like TFTs, Engineering stations, switches, Printers, ,etc., Master Clock Panel, LVS, PADO & Simulator System .

Each UPS system shall be connected to DDCMIS/PLC through soft as well as hard wired. All parameters which are transmitted from UPS shall be shown on HMI mimics.

# ERECTION HARDWARES

## 1.00.00 GENERAL TECHNICAL REQUIREMENTS

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

However, any item required for erection of Bidder supplied system but not categorically indicated in this section, shall be supplied by the Bidder and all these items shall conform to International / National standards / codes.

1.01.00 Electrical Accessories

Electrical conduit and associated materials shall conform to the requirements of the articles which follow :

a) Rigid Steel Conduit

i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.

ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.

iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with IS:9537 Part-I (1980) and Part-II(1981).. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel lacker or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.

iv) All rigid conduit fittings shall conform to requirements of IS:2667,1976. Galvanised steel fittins shall be used wth steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fitting shall be compatiable with the flexible conduit supplied.

b) Flexible Conduit

i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.

ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.

c) Special Fittings

i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.

ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

1.02.00 Electrical Junction Box:

Please refer to Section VII , Subsection – D of this volume of the Specification.

1.03.00 Cable Gland

| | | |
|---|---|---|
| 1. | Type | : Double compression |
| 2. | Entry Thread | : NPT / ET |
| 3. | Material | : Brass |
| 4. | Finish | : Cadmium Plated. |
| 5. | Protection | : IP 54 or better |
| 6. | Accessories | : Neoprene gasket, locknuts, reducers etc |

1.04.00 Cable Tray

| | | |
|---|---|---|
| 1. | Material | : Mild steel, slotted |
| 2. | Thickness | : not less than 2.0 mm |
| 3. | Finish | : Hot dip galvanized |
| 4. | Perforation | : As per MFR standard |
| 5. | Cover | : Suitable for tray |

1.05.00 Process Hook Up Accessories & specification

Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.

1.05.01 Seamless Stainless Steel Pipe

| | | |
|---|---|---|
| 1. | Reference | : ASTM A-312 TP 316 |
| 2. | Material Grade | : TP 316 |
| 3. | Type | : Seamless /Plain end |
| 4. | Size | : As applicable (e.g.½" NB etc) |
| 5. | Schedule | : 40 |
| 6. | Standard Length | : 5 meter |

1.05.02 Stainless Steel Pipe Fittings

| | | | |
|---|---|---|---|
| | 1. | Reference | : ASTM A-182 F 316 / ANSI B16.11 |
| | 2. | Type | : Forged |
| | 3. | Rating | : 3000 lbs / 6000 lbs / 9000 lbs |
| | 4. | Size | : To suit related SS pipe. |
| | 5. | End connection | : Generally socket weld |
| | 6. | Type of Fittings | : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. |

1.05.03 Seamless Stainless Steel Tube

| | | | |
|---|---|---|---|
| | 1. | Reference | : ASTM A-213 , ASTM A-249 or ASTM A-269 |
| | 2. | Material Grade | : TP 316 |
| | 3. | Size | : As applicable (e.g.½" OD X 0.083" wall thickness / ¼" OD X 0.049" wall thickness etc.) |
| | 4. | Type | : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube. |
| | 5. | Properties | : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80. |
| | 6. | Test Pressure | : 400 Kg/Sq. cm (minimum) |
| | 7. | Tolerance | : ± 0.13 mm for outside diameter |
| | | | : ± 15 % for wall thickness |
| | 8. | Standard Length | : 5 meter |
| | 9. | Test | : Flare, Hardness, Ball and Bubble Test |

1.05.04 Stainless Steel Tube Fittings

| | | | |
|---|---|---|---|
| | 1. | Reference | : ASTM-A-182 |
| | 2. | Type | : Double ferrule double compression |
| | 3. | Material | : 316 Stainless steel forged |
| | 4. | Ferrule | : 316 Stainless Steel |

| | | | |
|---|---|---|---|
| | 5. | Type of Fittings | : Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation. |
| | 6. | Size | : To suit SS tubing and NPT end connection |

1.05.05 C.S. Pipe

| | | | |
|---|---|---|---|
| | 1. | Reference | : ASTM-A 106 Gr. C |
| | 2. | Material | : Cold drawn seamless black C.S. |
| | 3. | Type | : Seamless / Plain ends |
| | 4. | Size | : As applicable (e.g. ½" NB etc) |
| | 5. | Schedule | : 80, 160, XXS as required |
| | 6. | Standard Length | : 5 meter |

1.05.06 C.S. Pipe Fittings

| | | | |
|---|---|---|---|
| | 1. | Reference | : ASTM-A 105 / ANSI B16.11 |
| | 2. | Type | : Forged |
| | 3. | Rating | : 3000 lbs / 6000 lbs / 9000 lbs |
| | 4. | Size | : Suitable to related C.S.Pipe |
| | 5. | End connection | : Generally socket weld |
| | 6. | Type of Fittings | : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. |

1.05.07 A.S. Pipe

| | | | |
|---|---|---|---|
| | 1. | Reference | : ASTM-A 335 P22 AS PER ANSI B 36.10 |
| | 2. | Material | : Cold drawn seamless A.S. |
| | 3. | Type | : Seamless / Plain ends |
| | 4. | Size | : As applicable (e.g. ½" NB etc) |
| | 5. | Schedule | : XXS |
| | 6. | Standard Length | : 5 meter |

1.05.08 A.S. Pipe Fittings

| | | | |
|---|---|---|---|
| 1. | Reference | : ASTM-A 182 F22 AS PER ANSI B 16.11 | |
| 2. | Type | : Forged | |
| 3. | Rating | : 9000 lbs | |
| 4. | Size | : Suitable to related A.S.Pipe | |
| 5. | End connection | : Generally socket weld | |
| 6. | Type of Fittings | : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. | |

1.05.09 G.I.Pipe

| | | | |
|---|---|---|---|
| 1. | Reference | : | IS-1239, Part-I |
| 2. | Type | : | Medium grade, threaded at both ends protected with end caps |
| 3. | Material | : | Continuous ERW galvanized MS pipe |
| 4. | General | : | Pipe shall be galvanized both inside and outside |
| 5. | Size | : | As applicable (e.g 1/2"/3/4"/1" etc.) |

1.05.10 G.I.Pipe Fittings

| | | | |
|---|---|---|---|
| 1. | Reference | : | IS-1239, Part-II for material, dimension, thread etc. |
| 2. | Style | : | Threaded |
| 3. | Type of Fittings | : | Equal tee, three piece union, unequal tee, straight socket, 90 Deg. elbow, reducing socket cap. etc. to suit installation. |
| 4. | Size | : | Suitable to related G.I.Pipe |

1.05.11 Carbon Steel Globe Valve

| | | |
|---|---|---|
| 1. | Reference | : ASTM A-105 |
| 2. | Type | : Globe |
| 3. | Construction | : Forged Body Cadmium Plated |
| 4. | End Connection | : As applicable ( eg. ½" Socket Weld etc.) |
| 5. | Rating | : Cl. 800 / CL. 2500 |

| | | | |
|---|---|---|---|
| | 6. | Material | : Body - Carbon steel |
| | | | : Stem - Hardened Steel |
| | | | : Plug - AISI 316 SS |
| | | | : Seat- Stainless steel stellited |
| | 7. | Packing | : Teflon / Grafoil as required |
| | 8. | Yoke | : ASTM A105 |
| | 9. | Hand wheel | : Carbon steel |
| | 10. | Design standard | : As per ANSI B 16.34 |

1.05.12 Stainless Steel Globe Valve

| | | | |
|---|---|---|---|
| | 1. | Reference | : ASTM A-182 F316 |
| | 2. | Type | : Globe |
| | 3. | Construction | : Forged Body |
| | 4. | End Connection | : As applicable ( eg. ½" Socket Weld etc.) |
| | 5. | Proof Pressure | : 400 Kg/Cm2 |
| | 6. | Material | : Body - Stainless steel |
| | | | : Stem - Hardened Steel |
| | | | : Plug - AISI 316 SS |
| | | | : Seat- Stainless steel stellited |
| | 7. | Packing | : Teflon as required |
| | 8. | Yoke | : ASTM A182 F316 |
| | 9. | Handwheel | : Carbon steel |
| | 10. | Design standard | : As per ANSI B 16.34 |

1.05.13 Alloy Steel Globe Valve

| | | | |
|---|---|---|---|
| | 1. | Reference | : ASTM A-182 F22 |
| | 2. | Type | : Globe |
| | 3. | Construction | : Forged Body |

| | | | |
|---|---|---|---|
| 4. | End Connection | : As applicable ( eg. ½" Socket Weld etc.) |
| 5. | Rating | : CL. 2500 |
| 6. | Material | : Body - Alloy steel |
| | | : Stem - Hardened Steel |
| | | : Plug - AISI 316 SS |
| | | : Seat- Stainless steel stellited |
| 7. | Packing | : Grafoil as required |
| 8. | Yoke | : ASTM A182 F22 |
| 9. | Handwheel | : Carbon steel |
| 10. | Design standard | : As per ANSI B 16.34 |

1.05.14 Structural Steel

Steel supports for JB's, trays; tubes and related equipments shall not be limited to the following:

a) MS Angle
b) MS Channel
c) I-Beam
d) Hexagonal head Bolt & Nut with washer
e) Foundation Bolt & Nut
f) Expansion Bolt
g) Steel Plates / Flats
h) CRCA sheet
i) 50 NB Pipe
j) Pipe clamps, U Bolts & Nuts
k) Checker plate

1.05.15 Condensate Pot

| | | |
|---|---|---|
| 1. | Reference | : ASTM A182 F22 /ASTM A105 |
| 2. | Material | : Alloy steel / carbon steel as per application |
| 3. | Construction | : Drilled from barstock |
| 4. | End connection | : As applicable (e.g 3 nos. ½" socket weld end etc.) |

| | | | |
|---|---|---|---|
| | 5. | Accessories | : Vent valves |

1.05.16 Instrument Valve Manifold

| | | |
|---|---|---|
| 1. | Type | : Two valve manifold |
| | | : Five valve manifold |
| 2. | Mounting | : Remote 2" Pipe Mounting / Transmitter Rack mounting |
| 3. | Construction | : Single block (bar stock) |
| 4. | Material | : Forged body and bonnet AISI 316 stainless steel |
| 5. | Ports | : Mfg std. ( e.g 1/2 " NPT (F) etc.) |
| 6. | Rating | : 420 Kg/Sq. cm at ambient |
| 7. | Operating Temperature | : (-)30 to (+)170 Deg C |
| 8. | Packing | : PTFE Wafer |
| 9. | Seat & Stem | : AISI 316 SS |
| 10. | Plug | : AISI 316 SS free to turn on stem / 17-4 PH |
| 11. | Handle Bar | : AISI 316 SS |
| 12. | Connection | : Straight |
| 13. | Accessories | : Plugs for all ports, Mounting Bracket , bolts , nuts |

1.06.00 Pneumatic Hook Up Accessories

1.07.00 Air Header

| **Technical Particulars** | **For Panel** | **For Field** |
|---|---|---|
| Material of Construction | : Stainless steel | : Stainless steel |
| Inlet Connection | : 2" NPT (M) | : 1" NPT (M) |
| Header Take-off Material | : Stainless steel | : Stainless steel |
| Take off connection | : 1 / 2" NPT (M) | : 1/ 2" NPT (M) |
| Take-off Valves Material | : stainless steel | : stainless steel |

| | | |
|---|---|---|
| Tube Take-off | : Tube adapter on valve | : Tube adapter on valve |
| Drain | : SS drain valve at lowest point | : SS drain valves at lowest point |

# KKS PHILOSOPHY

DOCUMENT TITLE

**KKS NUMBERING PHILOSOPHY**

## KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| X | X | X | A A Y | | | Y B B | B | | |

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-**1.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3.**

## ANNEXURE-1

**List of System / Sub-System Codes used in Power Plant:**

1) Compressed air system : QEA, QEC
2) Ventilation System : SAA TO SAZ
3) Fire Detection & Protection System + Fire Water pumps : SGM, SGN, SGO, SGP
4) Sewage Treatment : SJA TO SJZ
5) Pre-treatment Plant : GBI, GBM, GBV
6) RO DM Plant : GCI, GCM, GBV

## ANNEXURE-2

**Standard Equipment Codes:**

| | |
|---|---|
| AA | Valves including drives, also hand operated |
| AB | Seclusions, Lock, Gates, Doors |
| AC | Heat Exchanger |
| AE | Turning, Driving, Lifting equipment |
| AF | Continuous conveyors, Feeders |
| AG | Generator Units |
| AH | Heating and Cooling Units |
| AK | Pressing and Packaging equipment |
| AM | Mixer, Stirrer |
| AN | Blower, Air Pumps / Fans, Compressor Units |
| AP | Pump Units |
| AT | Purification, Drying, Filter |
| AV | Combustion Equipment e.g. grates |

**Standard Apparatus Codes:**

| | |
|---|---|
| BB | Vessels and Tank |
| BF | Foundation |
| BG | Boiler Heating Surfaces |
| BN | Injector, Ejector |
| BP | Flow and throughput limitation equipment (Orifice) |
| BQ | Holders, Carrying Equipment, Support |
| BR | Piping, Ducts, Chutes, Compensator |
| BS | Sound Absorber |
| BU | Insulations, Sheatings |

**Standard Measuring Circuits Codes:**

| | |
|---|---|
| CD | Density |
| CE | Electrical Quantities |
| CF | Flow, throughput |
| CG | Distance, Length, Position |
| CK | Time |
| CL | Level |
| CM | Humidity |
| CQ | Analysis (SWAS) |
| CS | Speed, Velocity, Frequency |
| CT | Temperature |
| CY | Vibration, Expansion |

**ANNEXURE-3**

## Numerical Keys

A) Numerical Keys at System Code Level

i) Use 10, 20, 30, ……. To distinguish between main systems having same Alpha Codes. Examples:

a) Main Steam (Left) and Main Steam (Right)

b) BFP – A/B/C

c) ID Fan – A/B, FD Fan A/B, AH – A/B

ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.

iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

i) Valves and Dampers --- *Equipment Code – AA*

N1 N2 N3

| | | | |
|---|---|---|---|
| Motorised *(on/off duty)* | - | *0* | *01 to 50* |
| *Motorised (inching duty)* | - | *0* | *51 to 99* |
| Pneumatic (Control) | - | *1* | *01 to 50* |
| *Motorised (thyrestor Control)* | - | *1* | *51 to 99* |
| Sol. Operated | - | 2 | 01 to 99 |
| (Open / Close duty (Valves, NRVs, Gate) | | | |
| Hydraulic | - | 3 | 01 to 99 |
| NRV (Without actuation) | - | 4 | 01 to 99 |
| Manual | - | 5 | 01 to 99 |
| Manual | - | 6 | 01 to 99 |
| Relief & Safety Valves | - | 7 | 01 to 99 |
| Reserve | - | 8 | 01 to 99 |
| Reserve | - | 9 | 01 to 99 |

ii) Field Instruments

| | | | |
|---|---|---|---|
| Field Transmitters & Analog Signals | - | 0 | 01 to 99 |
| Field Switches & Binary Signals | - | 1 | 00 to 99 |
| PG Test Point | - | 4 | 00 to 99 |
| Gauges | - | 5 | 00 to 99 |
| Automatic Turbine Tester (ATT)-HWR | - | 2 | 00 to 99 |
| (Reserved for protection Signals used by Hardwar) | | | |

**Example of Numerical Key Usage:**

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ……. Where system code is same.

# LCP and JUNCTION BOXES SPECIFICATION

1.00.00 **GENERAL REQUIREMENT**

1.01.00 ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT

1.01.01 All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.

1.02.00 SURFACE PREPARATION & PAINTING

1.02.01 All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.

1.02.02 Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.

1.02.03 Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:

- Exterior – Opaline green shade 275 of IS: 5 or equivalent international code..
- Interior - Brilliant White.

1.02.04 Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.

1.03.00 WIRING

1.03.01 All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.

1.03.02 Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.

1.03.03 All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.

1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices

1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.

1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.

1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.

1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.

1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.

1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.

1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.

1.04.00 TERMINAL BLOCKS

1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.

1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.

1.04.03 The characteristics of the terminal blocks shall be as follows.

i) High contact force, independent of conductor cross-section and large contact surface area.

ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.

iii) Inspection and maintenance free (resistant to thermal aging and vibration)

iv) Low and constant voltage drop

1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.

1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.

1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.

1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.

1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.

1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.

1.04.11 Other requirements of the terminal blocks are as follows:

i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.

ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.

iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.

iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.

v) Where more than one connection to a terminal block is required, two tier terminals shall be used.

1.05.00 GROUNDING

1.05.01 Separate Protective and Electronic system ground as required shall be provided.

1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.

1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground .The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open .The electronic ground between panels of a shipping section shall be firmly looped.

2.00.00 **CONTROL DESKS & PANELS**

2.01.00 GENERAL

2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &

accessories as required for completeness of the system.

2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.

2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.

2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.

2.01.05 For Control desk/ panel mounted instruments/ devices etc. which are to be powered from UPS, all required conversion of interface equipments/ accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS redundant feeders shall be provided wih suitably rated MCB and provision of fast auto changeover of UPS feeders.

2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

2.01.07 Nameplate

a) Nameplate shall be provided for instrument or device mounted on the panel.

b) Nameplates for panels shall be provided both in front and rear.

2.02.00 CONTROL DESK

2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.

2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.

2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.

2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

2.02.05 Design shall include Earthing bolts.

2.02.06 Back installed items shall be suitably concealed from front view.

2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.

2.02.08 HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)

Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.

2.03.00 BACK UP PANEL

2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.

2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.

2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.

2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also

be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (PLC/Relay based) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in sub-racks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

| | | | | |
|---|---|---|---|---|
| 1. | Material of Construction | : | Cold Rolled Coal Annealed (CRCA) steel sheet | |
| 2. | Thickness of Sheet | : | a) | 2.0 mm for faces supporting instruments / terminals |
| | | : | b) | 1.6 mm for other sides and top |
| 3. | Construction | : | Welded throughout as per approved National Standards | |
| 4. | Post welding operation | : | a) | Grounding of all welds to smoothness |
| | | : | b) | Rounding of corners |

| | | | | |
|---|---|---|---|---|
| | | : | c) | Cleaning of weld spatters |
| 5. | Panel height | : | 2300 mm (approx) | |
| 6. | Corners | : | 7 mm inner radius | |
| 7. | Dimensional Tolerances | : | a) | In height & length - 3 mm |
| | | | b) | In height between adjacent sections - 2 mm |
| | | | c) | Total for a group - 6 mm |
| 8. | Doors | : | Double, recessed, turned back edges, full height front & rear | |
| | i) Thickness of Sheet | : | 2 mm | |
| | ii) Hinges | : | Stainless steel | |
| | iii) Door latches | : | Three point type | |
| | iv) Door gaskets | : | Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure | |
| | v) Opening of the doors | : | Outward | |
| | vi) Louvers | : | With removable wire mesh to ensure dust and vermin proof | |
| 9. | Gland plates | : | Removable in sections<br>4 mm thick (bottom) | |
| 10. | Cable entry | : | Bottom | |
| 11. | Hardware | : | a) | Anti vibration pad- 15 mm |
| | | | b) | Predrilled base channel ISMC – 100 or equivalent for all sides |
| | | | c) | Stainless steel buff- finished 2 mm thick kick plate for all sides |
| | | | d) | Stainless steel scratch strips along desk edges fixed with pan-head recessed screws |
| | | | e) | Rubber strips to ensure air |

tightness between kick plate and finished floor

f) Lifting hook / Eye bolt

g) Drawing pocket

h) Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixures

| | | | |
|---|---|---|---|
| 12. | Name Plate | : | Both at front and back surface of the panel |
| 13. | Fixing of name plate | : | Stainless steel pan head screws |
| 14. | Name plate material | : | Laminated phenolic (3 layers) |
| 15. | Lettering | : | Black with white engraved |
| 16. | Mounting of terminal blocks | : | Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure |

## 2.05.00 FURNITURE

All the furnitures in the Central / Local control Room (s), Engineers' rooms, Instrument laboratory , SWAS Room & any other rooms with C&I equipments located in different plant buildings under Bidder's scope shall be included in Bidder's scope of supply. Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

### 2.05.01 WORK STATION FURNITURE

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

### 2.05.02 PC RACK

PC Racks shall be provided to mount CPUs of workstations/PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

### 2.05.03 CHAIRS

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

2.05.04 TABLES

Industry standard computer tables shall be provided & shall be as approved by Owner during detailed Engineering. Glass top teak wood horse shoe shaped table with vertical file mounting arrangement (two layers to house approx. 40 Nos of files and lockable drawers at both ends) for Engineering Room shall be provided.

2.05.05 ALMIRAHS

Steel Almirahs shall be provided for keeping documents in the documentation room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed Engineering.

2.05.06 KEYPAD

One keypad per unit shall be provided for the storing of keys of relevant areas of the unit in the control room.

2.05.07 LOCKERS

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel. Also, lockers of bigger size shall be provided in documentation Room for storing of personal documents. Details shall be finalized and approved by Employer during detailed engineering.

4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**

4.01.00 GENERAL

4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.

4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.

4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.

4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.

4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.

4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging

4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.

4.01.08 Earth stud shall be furnished at rack for safety grounding.

4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)

4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.

4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.

4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

member, which would reduce access, shall be avoided.

4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.

4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.

4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.

4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.

4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.

4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations

4.03.00 LOCAL INSTRUMENT RACK (LIR)

4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or

falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.

4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack

4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

| | | | |
|---|---|---|---|
| 1. | Type of Enclosure | : | Dust tight & weatherproof conforming to IP 65 |
| 2. | Material | : | 3 mm sheet steel / fiberglass reinforced polyester(UV stabilized) |
| 3. | Type of Cover | : | Solid unhinged with retention chain / Screwed at all four corners |
| 4. | Paint | : | i) Exterior : Opaline green shade 275 of IS: 5<br>ii) Interior - Brilliant Glossy White. |

| | | | |
|---|---|---|---|
| | | | Surface / Two (2) inch Pipe stanchion |
| 5. | Mounting | : | (At a dry compartment at one side of the enclosure / rack with front opening type door) |
| 6. | Cable Entry | : | 3 mm (min) Bottom / side Gland plate |
| 7. | Gasket | : | Neoprene |
| 8. | Grounding | : | Brass earth lug with green screw head External-2 nos , Internal-1no. (M6) |
| 9. | Number of Drain Holes | : | Two at bottom capped |
| 10. | Identification | : | Label for JB and Tags for cable |
| 11. | Accessories | : | a) Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals<br>b) Cable gland (Brass) & raceways<br>c) Ferrules & lugs (Brass)<br>d) Aluminum back panel<br>e) Canopy at top<br>f) Mounting brackets<br>g) bolts and nuts made of brass etc. |

FORM NO. PEM-6666-0

| | DATA SHEET FOR LOCAL PANELS | SPECIFICATION NO.: PE-SS-999-145-054A | |
|---|---|---|---|
| | | VOLUME | |
| | | SECTION | |
| | | REV. NO. 02 | DATE: 16.09.2013 |
| | | SHEET 1 OF 3 | |

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

**Data Sheet A & B**

| | | | DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER) | DATA SHEET-B (TO BE FILLED-UP BY BIDDER) |
|---|---|---|---|---|
| **GENERAL** | MANUFACTURER | | | |
| | CONSTRUCTION | | ■ FOLDED ☐ WELDED | |
| | ENCLOSURE SHEET THICKNESS **(As per Section 8.13,Volume V of contract specification)** | FRONT | ☐2.0 mm | |
| | | OTHER | ☐ 2.0 mm | |
| | | DOOR | ☐ 1.6 mm | |
| | | HEIGHT | ☐ 2365 mm for stand alone panels. ☐ Other ..... | |
| | | OTHER | ☐ Load bearing sheet front shall have 3mm thickness | |
| **TECHNICAL** | INPUT POWER SUPPLY * **(As per Electrical specification)** (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY) | | ☐ 240V 50 Hz AC ☐ 220V DC ■ 415V 3 PHASE 3W ☐ 400V 3 PHASE 4W | |
| | NO. OF FEEDERS **(As per Electrical specification)** | | ☐ ONE ☐ TWO | |
| | STARTER WITH MCC | | ☐ REQUIRED ■ NOT REQUIRED | |
| | IPR POSITION | | ■ MCC ☐ RELAY PANEL | |
| | CONTACT RATING OF RELAY | | ■ 5 Amp, 230 V AC ■ 0.25 Amp, 220V DC | |
| | CONTROL SUPPLY | | ☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement) | |
| | ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES) | | _____NOS. (AS REQUIRED) | |
| | TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C ) | | ☐ REQUIRED ■ NOT REQUIRED | |
| | PAINT TYPE **(As per Annex-1,Section 7.6,Voulme IV of contract specification)** | | ☐ EPOXY ENAMEL ☐ EPOXY POWDER COATED | |
| | MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.) | | ■ REQUIRED ☐ NOT REQUIRED | |
| | PANEL COLOUR (EXTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)** | | ☐ LIGHT GREY ☐ OPALINE GREEN | |
| | FINISH (EXTERNAL) **(As per Annex-1, Section 7.6,Voulme IV of contract specification)** | | ☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY | |
| | PANEL COLOUR (INTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)** | | ☐ WHITE ☐ CREAM ☐ OFF WHITE | |
| | FINISH (INTERNAL) **(As per Annex-1,Section 7.6,Voulme IV of contract specification)** | | ☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY | |
| | CLASS OF PROTECTION | | ■ IP-55 (FOR INDOOR SERVICE) ■ IP-67 (FOR OUTDOOR SERVICE) ☐ ANY OTHER | |
| | CONTROL HARDWARE | | ■ RELAY BASED | |
| | FOUNDATION ARRANGEMENT | | ☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS | |
| | WEIGHT OF PANEL (Kg.) | | .....(Vendor to specify ) | |

FORM NO. PEM-6666-0

| | | |
|---|---|---|
| | **DATA SHEET FOR LOCAL PANELS** | SPECIFICATION NO.: PE-SS-999-145-054A |
| | | VOLUME |
| | | SECTION |
| | | REV. NO. 02 / DATE: 16.09.2013 |
| | | SHEET 2 OF 3 |

TAG No. ……. Qty.....  Data Sheet No.: **PES-145A-DS1-0**

**Data Sheet A & B**

| | DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER) | | | DATA SHEET-B (TO BE FILLED-UP BY BIDDER) |
|---|---|---|---|---|
| | PANEL TYPE | ☐ PRESSURISED ☐ UNPRESSURISED As per Requirement | | |
| | CABLE GLAND | ■ DOUBLE COMPRESSION | | |
| | AMMETER (TYPE OF INPUT) * | ☐ 1 Amp CT | ☐ 4-20 mA | |
| | SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING | ☐ APPLICABLE | ■ NA | |
| | * TO BE CO-ORDINATED WITH PEM ELECTRICAL | | | |

| | PREPARED BY | CHECKED BY | APPROVED BY | COMPANY SEAL |
|---|---|---|---|---|
| NAME | AANCHAL CHOUDHARY | SACHIN SRIVASTAVA | MA MANSOORI | NAME: |
| DESIGNATION | SR.ENGR | DY.MNGR | D. GM | |
| SIGNATURE | | | | SIGNATURE: |
| DATE | 16.09.2013 | 16.09.2013 | 16.09.2013 | DATE: |

FORM NO. PEM-6666-0

| | DATA SHEET FOR LOCAL PANELS | SPECIFICATION NO.: PE-SS-999-145-054A | |
|---|---|---|---|
| | | VOLUME | |
| | | SECTION | |
| | | REV. NO. 02 | DATE: 16.09.2013 |
| | | SHEET 3 OF 3 | |

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

**Data Sheet C**

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

| | | | | |
|---|---|---|---|---|
| **GENERAL** | MANUFACTURER | | | |
| | CONSTRUCTION | | ☐ FOLDED ☐WELDED (As per requirement EDN) | |
| | ENCLOSURE SHEET THICKNESS | FRONT | | |
| | | OTHER | | |
| | | DOOR | | |
| | | HEIGHT | | |
| | | OTHER | | |
| **TECHNICAL** | INPUT POWER SUPPLY | | | |
| | NO. OF FEEDERS | | | |
| | CONTACT RATING OF RELAY | | | |
| | TEMP SCANNER | | | |
| | CONTROL SUPPLY | | | |
| | ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES) | | | |
| | PAINT TYPE | | | |
| | PANEL COLOUR (EXTERNAL) | | | |
| | FINISH (EXTERNAL) | | | |
| | TYPE OF MIMIC<br>MATERIAL OF MIMC<br>THICKNESS OF MIMIC | | | |
| | PANEL COLOUR (INTERNAL) | | | |
| | FINISH (INTERNAL) | | | |
| | CLASS OF PROTECTION | | | |
| | CONTROL HARDWARE | | | |
| | FOUNDATION ARRANGEMENT | | | |
| | WEIGHT OF PANEL (Kg.) | | | |

FORM NO. PEM-6666-0

| | DATA SHEET FOR LOCAL PANELS | SPECIFICATION NO.: PE-SS-999-145-054A | |
|---|---|---|---|
| | | VOLUME | |
| | | SECTION | |
| | | REV. NO. 02 | DATE: 16.09.2013 |
| | | SHEET 3 OF 3 | |

TAG No. ……. Qty..... Data Sheet No.: **PES-145A-DS1-0**

**Data Sheet C**

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

| | | | |
|---|---|---|---|
| | PANEL TYPE | | |
| | CABLE GLAND | | |
| | AMMETER (TYPE OF INPUT) | | |
| | SCOPE OF SUPERVISION | | |

| | PREPARED BY | CHECKED BY | APPROVED BY | COMPANY SEAL |
|---|---|---|---|---|
| NAME | AANCHAL CHOUDHARY | SACHIN SRIVASTYAVA | MA MANSOORI | NAME: |
| SIGNATURE | | | | SIGNATURE: |
| DATE | 16.09.2013 | 16.09.2013 | 16.09.2013 | DATE: |

# Instrumentation Quality Plan

## STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

### CHECK LIST FOR PRESSURE SWITCH

| Sl. No. | Test / Checks | Quantum of check | Reference Doc. / Acceptance Norms | Agency ** | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | M | C | B | |
| 1 | CHECK FOR | SEE NOTE-1 BELOW | APPROVED SPEC./ DATA SHEETS | P | V | V | |
| | 1.1 MODEL NO/TAG NO | | | | | | |
| | 1.2 RANGE | | | | | | |
| | 1.3 END CONN | | | | | | |
| | 1.4 NO. OF CONTACT | | | | | | |
| 2 | CALIBRATION | | | P | V | V | |
| | 2.1 REPEATABILITY | | | | | | |
| | 2.2 SET POINT ADJUSTMENT | | | | | | |
| | 2.3 DIFFERENTIAL | | | | | | |
| 3 | OVER PR & LEAK TEST | | | P | V | V | |
| 4 | ELECT. INSULATION/HV TEST | ONE | | P | V | V | |
| 5 | REVIEW OF TC FOR MATERIALS OF | FOR LOT | | V | V | V | |
| | 5.1 SENSOR | | | | | | |
| | 5.2 MOVEMENT | | | | | | |
| | 5.3 PROCESS CONNECTION | | | | | | |
| | 5.4 HOUSING | | | | | | |
| 6 | REVIEW OF TC FOR DEGREE OF PROTECTION | TYPE TEST | | V | V | V | |
| 7 | REVIEW OF TC OF MICROSWITCH | FOR LOT | | V | V | V | |

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

**Note :**

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to carry out ROUTINE TEST on 100 %.
3. Contractor to provide compliance certificate for tests/checks verifid by contractor and the same alongwith test certificates to be verified by BHEL

## STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

### CHECK LIST FOR TRANSMITTER

| Sl. No. | Test / Checks | Quantum of check | Reference Doc. / Acceptance Norms | Agency ** | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | M | C | B | |
| 1 | CHECKS FOR | SEE NOTE-1 BELOW | APPROVED SPEC./ DATA SHEETS | P | W | V | |
| | VISUAL. | | | | | | |
| | MODEL/TAG No | | | | | | |
| 2 | PROCESS CONNECTION | | | P | W | V | |
| 3 | ACCURACY | | | P | W | V | |
| 4 | REPEATABILITY | | | P | W | V | |
| 5 | HYSTERESIS | | | P | W | V | |
| 6 | EFFECT OF TEMP VARIATION ON ACCURACY | | | P | W | V | |
| 7 | SPAN / ZERO ADJUSTMENT | ONE / TYPE | | P | W | V | |
| 8 | EFFECT OF SUPPLY VOLTAGE VARIATION | | | P | W | V | |
| 9 | EFFECT OF LOADING (500 OHM METERS) | | | P | W | V | |
| 10 | HIGH PRESSURE TEST | SEE NOTE-1 BELOW | | P | W | V | |
| 11 | BURN-IN TEST | ONE / TYPE | | P | W | V | |
| 12 | DEGREE OF PROTECTION | | | P | W | V | |
| 13 | ACCESSORIES AS APPLICABLE | SEE NOTE-1 BELOW | | V | V | V | |

**Legend :**

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

**Note :**

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. When material corelation are not available manufacturer's compliance to be provided.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

## STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

### CHECK LIST FOR PRESSURE & DP GAUGE

| Sl. No. | Test / Checks | Quantum of check | Reference Doc. / Acceptance Norms | Agency ** | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | M | C | B | |
| 1 | CHECK FOR | SEE NOTE-1 BELOW | APPROVED SPEC./ DATA SHEETS | P | W | V | |
| | SENSOR TYPE | | | | | | |
| | DIAL SIZE | | | | | | |
| | MODEL NO/TAG NO | | | | | | |
| | RANGE/SCALE | | | | | | |
| | SWITCH CONTACT RATING & NOS. | | | | | | |
| | END CONNECTION | | | | | | |
| 2 | CALIBRATION | | | P | W | V | |
| | ACCURACY | | | | | | |
| | REPEATABILITY | | | | | | |
| | SET POINT ADJUSTMENT | | | | | | |
| 3 | OVER PRESSURE & LEAK TEST | | | P | W | V | |
| 4 | OPERATION OF PRESSURE. RELIEF DEVICE | ONE | | P | W | V | |
| 5 | REVIEW OF TC FOR | FOR LOT | | V | V | V | |
| | MATERIALS OF SENSOR | | | | | | |
| | MOVEMENT | | | | | | |
| | PROCESS CONNECTION | | | | | | |
| | HOUSING | | | | | | |
| 6 | REVIEW OF TC FOR DEGREE OF PROTECTION | TYPE TEST | | V | V | V | |
| 7 | ACCESSORIES AS APPLICABLE | SEE NOTE-1 BELOW | | V | V | V | |
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**Legend :**

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

**Note :**

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. When material corelation is not available, MFR's compliance to be provided
5. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

## STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

### CHECK LIST FOR LEVEL GAUGE

| Sl. No. | Test / Checks | Quantum of check | Reference Doc. / Acceptance Norms | Agency ** | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | M | C | B | |
| 1 | CHECK FOR | SEE NOTE-1 BELOW | APPROVED SPEC./ DATA SHEETS / DRWGS | P | W | V | |
| | TYPE | | | | | | |
| | MODEL/ TAG NO. | | | | | | |
| | DAIL SIZE | | | | | | |
| | RANGE/SCALE | | | | | | |
| | END CONNECTION | | | | | | |
| 2 | DIMENSIONS, PROCESS CONNECTION | | | P | W | V | |
| 3 | ACCURACY | | | P | W | V | |
| 4 | MATERIAL TC FOR | ONE / LOT | | P | V | V | |
| | BODY ISO. | | | | | | |
| | VALVE | | | | | | |
| | GAUGE GLASS | | | | | | |
| 5 | HYD. TEST | SEE NOTE-1 BELOW | | P | W | V | |
| 6 | ACCESSORIES AS APPLICABLE | | | P | W | V | |
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**Legend :**

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

**Note :**

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

## STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

### CHECK LIST FOR ANNUNCIATORS

| Sl. No. | Test / Checks | Quantum of check | Reference Doc. / Acceptance Norms | Agency ** | | | Remarks |
|---|---|---|---|---|---|---|---|
| | | | | M | C | B | |
| 1 | CHECK FOR | SEE NOTE-1 BELOW | APPROVED SPEC./ DATA SHEETS | P | W | V | |
| | TYPE/ MODEL | | | | | | |
| | DIMENSIONS OF HARDWARE | | | | | | |
| | MODULARITY | | | | | | |
| | SEQUENCE | | | | | | |
| | FACIA DETAILS | | | | | | |
| 2 | FUNCTIONAL TEST | 100% | | P | W | V | |
| 3 | IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY | SEE NOTE-1 BELOW | | P | W | V | |
| 4 | DEGREE OF PROTECTION FOR ENCLOSURE | TYPE TEST | | P | W | V | |
| 5 | I/R CHECK | SEE NOTE-1 BELOW | | P | W | V | |
| 6 | RESPONSE | | | P | W | V | |
| | | | | | | | |
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**Legend :**

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

**Note :**

1. Quantum of check shall be as below :
   100 % - By Manufacturer
2. Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
3. Manufacturer to carry out ROUTINE TEST on 100 %.
4. Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.

# LCP Quality Plan

PEM :: C&I

# STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

| | |
|---|---|
| STD QUALITY PLAN NO.: | **PE-QP-999-145-I056** |
| VOLUME | IIB |
| SECTION | D |
| REV. NO. | 01 DATE: 22-02-2008 |
| SHEET | 1 OF 7 |

| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency $ P | Agency $ W | Agency $ V | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **INCOMING** | | | | | | | | | | | |
| 1.0 | Sheet Steel (CRCA & HR) | 1. Chemical Composition | MA | Chemical analysis | Sample | Relevant standard | Relevant standard | Test Certificate | 3 | --- | 2 | |
| | | 2. Bend Test | CR | Mech. test | Sample | Relevant standard | Relevant standard | Log Book | 2 | --- | --- | |
| | | 3. Surface finish | MA | Visual | 100% | Factory Standard / Sample | Factory Standard / Sample | Log Book | 2 | --- | --- | |
| | | 4. Waviness | MA | Visual | 100% | Factory Standard | No Waviness | Log Book | 2 | --- | --- | |
| | | 5. Thickness | MA | Measurement | 100% | BHEL Spec. | BHEL Spec. | Log Book | 2 | --- | --- | |
| | | 6. Mill marking | MA | Visual | 100% | Factory Standard | Factory Standard | Log Book | 2 | --- | 1 | |
| 2.0 | Flats / Angles / Channels | 1. Dimensions | MA | Measurement | Sample | Relevant standard | Relevant standard | Log Book | 2 | --- | --- | |
| | | 2. Surface Defects | MA | Visual | 100% | Factory Standard / Sample | Factory Standard / Sample | Log Book | 2 | --- | --- | |
| | | 3. Straightness | MA | Measurement | 100% | Factory Std. | Factory Std. | Log Book | 2 | --- | --- | |
| | | 4. Mill marking | MA | Visual | 100% | Relevant standard | Relevant standard | Log Book | 2 | --- | 1 | |
| 3.0 | Cables / Wires | 1. Visual / Surface defects | MA | Visual | 100% | BHEL Spec. and Relevant standard | BHEL Spec. and Relevant standard | Log Book | 2 | --- | --- | |
| | | 2. IR and HV | MA | Electrical | 100% | BHEL Spec. and Relevant standard | BHEL Spec. and Relevant standard | Log Book | 2 | --- | --- | |

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.

1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

# STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

| | |
|---|---|
| STD QUALITY PLAN NO.: | **PE-QP-999-145-I056** |
| VOLUME | IIB |
| SECTION | D |
| REV. NO. | 01 DATE: 22-02-2008 |
| SHEET | 2 OF 7 |

| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency $ P | Agency $ W | Agency $ V | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3. Conductor<br>a) Resistance<br>b) Size<br>c) Sheet colour | <br>MA<br>MA<br>MA | <br>Electrical<br>Measurement<br>Visual | <br>100%<br>100%<br>100% | BHEL Spec. and Relevant standard | BHEL Spec. and Relevant standard | Log Book | 2 | --- | --- | |
| | | 4. Type / Routine Test Certificates | MA | Verification | 100% | BHEL Spec. and Relevant standard | BHEL Spec. and Relevant standard | Log Book | 3 | --- | 2 | |
| 4.0 | Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc. | 1. Verification at make and Type | CR | Visual | Sample | BHEL Spec. and BOM | BHEL Spec. and BOM | Log Book | 2 | --- | --- | |
| | | 2. Verification of Test Certificates | CR | Scrutiny of Type / Routine T.Cs. | 100% | Relevant standard | Relevant standard | Log Book | 2 | --- | --- | |
| | | 3. Operation / Functional check | CR | Electrical | Sample+ 100%@ | Relevant standard & Catalogue | Relevant standard & Catalogue | Log Book | 2 | --- | --- | + for relay & contactors only |
| | | 4. I.R. | MA | Electrical | 100% | Relevant standard & Catalogue | Relevant standard & Catalogue | Log Book | 2 | --- | --- | @ for all components except relays & contactors. |
| | | 5. H.V. | MA | Electrical | 100% | Relevant standard & Catalogue | Relevant standard & Catalogue | Log Book | 2 | --- | --- | |
| | | 6. Calibration | MA | Electrical | 100% | Relevant standard & Catalogue | Relevant standard & Catalogue | Log Book | 2 | --- | 1 | |
| | | 7. Pick up / Drop off Voltage | MA | Electrical | 100% | Relevant standard & Catalogue | Relevant standard & Catalogue | Log Book | 2 | --- | --- | |

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.

1 - BHEL 2 - Vendor 3 - Sub-vendor

PEM :: C&I

# STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

| | |
|---|---|
| STD QUALITY PLAN NO.: | **PE-QP-999-145-I056** |
| VOLUME | IIB |
| SECTION | D |
| REV. NO. | 01 DATE: 22-02-2008 |
| SHEET | 3 OF 7 |

| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency $ | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | W | V | |
| 5.0 | Misc. Components like Gaskets, Terminal Blocks etc. | 1. Verification of Type / Make | MA | Visual | Sample | BHEL Spec. & Mfrs. Catalogue | BHEL Spec. & Mfrs. Catalogue | Log Book | 2 | --- | --- | |
| | | 2. Surface defects | MA | Visual | Sample | BHEL Spec. & Mfrs. Catalogue | BHEL Spec. & Mfrs. Catalogue | Log Book | 2 | --- | --- | |
| | | 3. IR / HV on Terminal Blocks | MA | Electrical | Sample | BHEL Spec. & Mfrs. Catalogue | BHEL Spec. & Mfrs. Catalogue | Log Book | 2 | --- | --- | |
| | **IN PROCESS** | | | | | | | | | | | |
| 6.0 | Blanking / Bending / Forming | 1. Dimensions | MI | Measurement | 100% | Approved Mfr. drgs. | Approved Mfr. drgs. | Log Book | 2 | --- | --- | |
| | | 2. Surface defects after bending | MA | Visual | 100% | Factory Standard | Factory Standard | Log Book | 2 | --- | --- | |
| 7.0 | Nibbling / Punching | 1. Cutout Sizes | MI | Measurement | 100% | Approved Mfr. drgs. | Approved Mfr. drgs. | Log Book | 2 | --- | --- | |
| | | 2. Deburring | MA | Visual | 100% | Approved Mfr. drgs. | Approved Mfr. drgs. | Log Book | 2 | --- | --- | |
| | **ASSEMBLY** | | | | | | | | | | | |
| 8.0 | Frame Assembly & Sheet fixing | 1. Dimensions | MA | Measurement | 100% | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book | 2 | --- | 2 | |
| | | 2. Alignment | MA | Measurement | 100% | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book | 2 | --- | 2 | |
| | | 3. Welding Quality | MA | Visual | 100% | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book | 2 | --- | 2 | |
| | | 4. Surface defects | MA | Visual | 100% | Approved drg. / Mfr. Standards | Approved drg. / Mfr. Standards | Log Book | 2 | --- | 2 | |

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

$ P - Agency Performing the Test.; W - Agency Witnessing the Test.; V - Agency Verifying the Test.

1 - BHEL; 2 - Vendor; 3 - Sub-vendor

PEM :: C&I

# STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL

| | |
|---|---|
| STD QUALITY PLAN NO.: | **PE-QP-999-145-I056** |
| VOLUME | IIB |
| SECTION | D |
| REV. NO. | 01 DATE: 22-02-2008 |
| SHEET | 4 OF 7 |

| Sl. No. | Component / operation | Characteristics Checked | * Category | Type/Method of Check | Extent of Check | Reference documents | Acceptance Norms | Format of Records | Agency $ | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | P | W | V | |
| 9.0 | Pre-treatment and Painting | 1. Pretreatment Process | MA | Visual | 100% | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book | 2 | --- | 1 | |
| | | 2. Process parameters like bath temp. concentration etc. | MA | Measurement | Periodic | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book | 2 | --- | 1 | |
| | | 3. Dipping / Removal Time | MA | Measurement | 100% | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book | 2 | --- | 1 | |
| | | 4. Surface quality after every dip | MA | Visual | 100% | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book | 2 | --- | 1 | |
| | | 5. Primer after phosphating | MA | Visual, Thickness | 100% | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book | 2 | --- | 1 | |
| | | 6. Putty Application & Rubbing after primer | MA | Visual | 100% | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book | 2 | --- | 1 | |
| | | 7. Paint first coat | MA | Visual, Thickness | 100% | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book | 2 | --- | 1 | |
| | | 8. Putty Application and Rubbing after first coat of paint | MA | Visual | 100% | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book | 2 | --- | 1 | |
| | | 9. Paint second coat | MA | Visual, Thickness, Scratch test Colour adhesion | 100% | Factory Standard & Relevant standard | Factory Standard & Relevant standard | Log Book | 2 | --- | 1 | |

LEGEND: * CR - Critical characteristics; MA - Major characteristics; MI - Minor characteristics

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1 - BHEL; 2 - Vendor; 3 - Sub-vendor