TECHNICAL SPECIFICATION

FOR

RATE CONTRACT OF

SELF CLEANING STRAINERS (SCS)

Specification No.: PE-TS- RC5-165-N004 Rev 00

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI BLDG., SEC-16A, PLOT NO. 25
NOIDA – 201301 (UP)

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THIS TECHNICAL SPECIFICATION CONSISTS OF FOLLOWING SECTIONS:

CONTENTS

Notes:

1. In case there is conflict in different clauses of specification, most stringent clause (as decided by BHEL / end customer) shall be followed, if no specific deviation is taken by bidder and accepted by BHEL during tender stage in that regard.

2. For detailed list of documents to be submitted by bidder in their technical offer, please refer cl. no. 13 of Section-IA.

3. For detailed list of documents to be submitted by vendor after award of contract, please refer Datasheet-C of Section-IIA.

SECTION - I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA - Specific Technical Requirements (Mech.)
SUB-SECTION IB - Specific Technical Requirements (Electrical)
SUB-SECTION IC - Specific Technical Requirements (C & I)
SUB-SECTION ID – Datasheet-A

SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

1.0 GENERAL

1.1 This specification is intended for finalization of rate contract between BHEL PEM and Bidder. Standard technical detail as indicated in the specification shall be agreed upon between BHEL PEM and Bidder. Project specific technical detail shall be made available to the bidder along with project enquiry.

1.2 This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works, proper packing for delivery installation checks, commissioning, Trail run and PG test for Self-Cleaning Strainer with mandatory spares complete with all accessories as per the requirements specified in this specification.

The Self Cleaning Strainer (SCS) complete with all accessories shall conform to the standard technical specifications (Section-II) and Data Sheet-A enclosed herewith. In addition, the requirements of this section I including customer specification attached (as applicable) shall also be complied with. However, wherever the details given in Section-II and Data Sheet-A are different, the requirements of Data Sheet-A shall prevail. Similarly, in the event of contradictions between Section-I/ customer specification (Annexure-IV) / Section-II/ Data Sheet-A, the same shall prevail in the order as: customer specification, Section-I, Datasheet-A, Section-II.

Section I consists of 4 Sub-Sections viz. Sub-Sec. IA, IB and IC for Mechanical, Electrical and C&I respectively and Sub-Section ID for Datasheet-A, the requirements of all 4 subsections shall be complied with.

NOTE: -

1. The specification is made with the intent of entering Rate Contract for the Supply, Commissioning, Trail run and PG test of Self Cleaning Strainer for various projects time to time**.**

2. Type of SCS have been detailed in Data Sheet-A, Section-1D. The bidder shall include complete supplies in his scope. Part supplies offered shall disqualify the bidder's offer. Evaluation shall be combined and further details shall be indicated in NIT.

List of Self Cleaning Strainer (SCS) for various water Application:

a) For CW Blow down water Application:

i) TYPE-1 Flow= 525 CUM/HR, SIZE= 300 NB
ii) TYPE-2 Flow= 150 CUM/HR, SIZE= 150 NB
iii) TYPE-3 Flow= 150 CUM/HR, SIZE= 150 NB
iv) TYPE-4 Flow= 650 CUM/HR, SIZE= 300 NB
v) TYPE-5 Flow= 250 CUM/HR, SIZE= 200 NB
vi) TYPE-6 Flow = 375 CUM/HR, SIZE=250 NB

Bidder to note that flow of SCS for various sizes may vary during detail engineering up to (+) 5%. Same shall be informed during project specific order. However maximum possible design parameters are indicated in the respective datasheet of each type in Section- ID of this specification. No commercial implication shall be applicable for the same.

1.3 The omission/ addition of specific reference to any component / accessory necessary for the proper performance of the equipment's shall not relieve the supplier of the responsibility of providing such facilities to complete the supply within the quoted prices.

1.4 The bids shall be evaluated as per NIT. Ordering shall be done separately for each project.

1.5 Bidder to quote for items as per price schedule attached in NIT. The quantity as mentioned in the BOQ is only for evaluation purpose. However actual ordered quantity may vary from project to project throughout the year.

2.0 DESCRIPTION OF EQUIPMENTS:

SELF CLEANING STRAINER (SCS).

The Self Cleaning Strainer (SCS) is intended to prevent accumulation of debris in ACW Pipeline. The water through the self cleaning strainers outlet shall be supplied to the Secondary side of Plate Heat Exchangers. The water analysis is indicated with Datasheet-A.

3.0 SCOPE OF SUPPLY UNDER THE SPECIFICATION IN THE BIDDER'S SCOPE FOR SELF CLEANING STRAINER (SCS).

3.1 The details of SCS with quantities, design parameters, size and MOC's as per Data Sheet-A.

3.2 SCOPE OF SUPPLY IN THE BIDDER'S SCOPE FOR SELF CLEANING STRAINER:

3.2.1 Each set of SCS shall comprise as following:

a) Flushing pump with drive Motor (if required) - 1 No.

b) **For CW Blow down water: -** Supply of complete interconnecting pipe (as applicable) and debris disposal pipe work including flanges/counter flanges, bends, fittings, supports, gaskets, fasteners etc. shall be in scope of Bidder. However, bidder is to consider debris disposal pipe length and no. of bends as per the list of BOQ mentioned in Data-Sheet A to this Section. In case actual piping comes out to be less than the BOQ of Data Sheet-A, still bidder has to supply the same as minimum requirement. Bidder shall finalize the pipework to suit the layout at contract stage in such a way that minimum site welding is required for pipework by purchaser at site.

c) Filter body/ housing Vent and drain connections along with their isolating valves.

d) Length of Self Cleaning Strainer, complete with bolts, nuts and gaskets shall be as per Data Sheet-A. Thickness of body flange shall be as per BS 4504/ equivalent standard.

e) Differential pressure measuring system for Self-Cleaning Strainer. DP measuring system shall comprise of 2 Nos. DPT + 1 No. DPG for each SCS and shall be with Remote seal arrangement. Stubs for DPT and DPG shall be independent.

f) The Electrical & C&I items/ accessories as specified in succeeding clause/respective sections herein.

g) Starter Panel (Switch Gear Panel) shall be as follows:

2 Sets of Self Cleaning Strainer shall have one Common Starter Panel (Switch Gear Panel) for DCS based control system. Switch Gear Panel should have suitable arrangement like Bus Coupler for providing redundancy to incoming supply feeder (1Working + 1 Standby feeder).

h) Power and Control cables between Starter Panel and various drives in bidder's scope of supply. Refer note at electrical scope between BHEL and Vendor in section IB.

i) All the field instruments stipulated in this specification shall be in Bidder's scope.

j) Set of commissioning spares, on "As required basis".

k) Set of mandatory spares as indicated in Data Sheet A.

l) Supporting arrangement complete with saddle support, foundation plates, anchor bolts, nuts, sleeves, inserts, all installation materials, fixing bolts, clamps and other accessories etc. for complete equipment supplied under this package.

m) Finish paints for touch up painting of equipment after erection at site, in sealed containers.

n) Set of special tools and tackles if required for maintenance and erection of the equipment supplied.

o) Various drawings, data test reports/ certificates instruction manuals for erection operation and maintenance etc. as specified in Data Sheet-C and cables schedule indicating BOQ for power & control cables.

p) Panels & Instruments: Scope and Type as specified in C&I section wherever required.

Any item not specified but required to make SCS complete package shall also be in bidder's scope.

4.0 SCOPE OF SERVICES INCLUDED IN THE BIDDER'S SCOPE:

The bidder's scope also includes following services at site, for scope under this specification for Self-Cleaning Strainer:

a) Installation checks (Erection in BHEL's scope).
b) Commissioning of equipment.
c) Performance Guarantee Testing.

PG Test of equipment shall be generally conducted immediately after commissioning. These activities for different units shall be timed separately.

- **For drawings/documents approval**

  In the event of order all drawings / documents in soft as well as hard copy shall be submitted as per Cl. No. 10.0.

  Further on receipt of Customer comments, if required bidder's engineer shall visit BHEL/ Customer along with soft copy to resolve all issues and incorporate comments in the soft copy for across the table finalization and Category-I approval.

- **Site Visits for installation check / commissioning / PG Test:**

  Bidder to include cost of site visits for installation check, commissioning and PG testing in their offer as price schedule.

5.0 EXCLUSIONS:

The following are excluded from the bidder's scope.

5.1 Civil foundation works required for installation

5.2 Erection of Equipment at site.

6.0 DESIGN CONSTRUCTION:

In addition to the requirements of Section-IIA the following shall also be complied.

6.1 Layout Piping Arrangement Drg. is enclosed in the specifications at Annexure-III of Datasheet-A.

6.2 Thickness of body flange and counter flange of SCS shall be as per BS 4504/ equivalent standard.

6.3 The materials of construction specified in Data Sheet-A are minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty which shall be subject to purchaser's approval during detailed engineering in the event of order.

6.4 Housing/ body of SCS shall be designed and manufactured as per the applicable codes for pressure vessels and to take care of force and moments as enclosed in the specification. However, in no case thickness of housing/ body shall be less than connecting pipe thickness as specified in Data Sheet-A of Self Cleaning Strainer.

6.5 Adequate provision for future installation of Cathodic Protection for Self-Cleaning Strainer (Sacrificial type) shall be kept by the bidder in the equipment.

6.6 Velocity in the pipe work shall be less than 1.5 m/ sec for pump suction and less than 2.0 m/ sec. in other pipe work. All valves upto 150 NB shall be ball valves. For higher sizes, gate/ globe/ B.F. valves shall be provided. All instrument valves shall be needle valves.

7.0 Performance Guarantee for SCS:

Performance Guarantee Parameters shall be as under:

- For Type-2: Max. Pressure drop in Self-Cleaning Strainer in clean condition (Test to be conducted along with commissioning) – not exceeding 2.50 MWC. The Bids shall be technically rejected for pressure drop quoted higher than 2.50 MWC.

- For other types: Max. Pressure drop in Self-Cleaning Strainer in clean condition (Test to be conducted along with commissioning) – not exceeding 1.0 MWC. The Bids shall be technically rejected for pressure drop quoted higher than 1.0 MWC.

Any deviation to above pressure drop will not be accepted.

In case the successful bidder fails to demonstrate above parameter, he shall carry out modifications at his own cost, to purchaser's approval.

In case bidder fails to demonstrate above parameter to purchaser's satisfaction even after modification carried by him at site, the purchaser has the right to reject the equipment out rightly and bidder is liable to resupply the equipment meeting the contractual performance parameters within time period mutually agreed upon without any cost implication to BHEL/Customer.

8.0 SPARES:

8.1 Mandatory Spares

Mandatory Spares shall be as per Data Sheet-A or annexure enclosed with data sheet A.

9.0 Quality Plan

Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ Customer approval and customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. Charges for 3rd party inspection (TUV/ equivalent) for imported components wherever required shall be included by bidder in the base price itself.
If BHEL or BHEL customer decides to witness the tests along with third party, the cost of travel of BHEL or BHEL customer shall be borne by BHEL or BHEL customer themselves.

10.0 DELIVERY & DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE:

Delivery of Equipment and drawing submission shall be as per NIT.

11.0 The make of various bought out items shall be subjected to approval of Customer/ BHEL in the event of order.

12.0 It is mandatory for the bidders to submit along with the bid the deviations if any whether major or minor in the schedule of deviations only. ***In the absence of deviations listed in the schedule of deviations the offer shall be deemed to be in full conformity with the specification "non-withstanding" anything else stated elsewhere in bidder's offer, data sheets etc. The implied/ indirect deviations in data sheets etc. Shall not be binding on the purchaser.***

13.0 The following documents shall be furnished by the bidder with his offer:

- Compliance certificate duly signed and stamped (Enclosed at Section III).
- Guarantee schedule duly signed and stamped (Enclosed at Section III).

- GA drawings of following with empty/ filled-ups.
  - SCS body/ housing (as applicable).
  - Flushing Skid (if any).
  - Other equipment considered necessary for Layout/ Civil.

- Electrical Load Data (Enclosed at Section III).
- Schedule of Deviation (Enclosed in NIT).

The bidder to note that load requirement furnished and finalized during tender stage shall only be provided by BHEL and any changes or additional requirement of Electrical load by bidder during contract stage shall be provided by BHEL with cost repercussions to the bidder.

NOTE: Apart from above, no other drawing/ document/ data sheet etc. shall be submitted along with the offer. If any drawing/ document etc. is submitted with the offer, same shall be considered as for 'Reference' purpose only and shall not be reviewed/ commented upon and any deviation, exclusion to scope, etc. taken in documents but not highlighted in the deviation schedule shall not be taken cognizance of.

14.0 Self-Cleaning Strainer packing procedure before dispatch

The purpose of this procedure is to outline the requirements and procedures for protecting the equipment's during shipment and preserving during the storage.

14.1 Preparation for Packing:

- After hydro testing, operation, all fluids e.g. water etc., shall be completely drained from all SCS's parts, and the equipment blown dry.
- All material shall be cleaned internally and externally to remove, scale, rust fillings and any other foreign material.
- The SCS shall be placed on a strong wooden base & bolted to the wooden base using the foundation holes for further transportation up to site.

14.2 Protection of parts:

- SCS Shell shall be packed-in properly in high grade bubble plastic wrap for transportation, and long duration storage at site.
- Actuators shall be packed in separate wooden box of proper sizes.
- SCS items (EXCEPT SCS Shell) shall be packed in proper sizes of wooden cases. High grade woods like Rubber woods, jungle wood, hard wood, mango wood, pine wood, etc. is used for packing.
- Loose material, Electrical & Electronics items shall be packed in corrugated box and plastic bags with proper tagging and marking of handle with care in proper sizes of wooden cases
- All finished (or) machined (External C.S. Surfaces shall be protected against corrosion with corrosion resisting coating, which is easily removable (Compound shall be such that it will remain on the surface at temperature normally encountered during shipping & storage).
- All machined surfaces shall be protected from mechanical damage. All external unfinished carbon steel surfaces shall be sand/shot blasted & shall be coated with rust preventive primer.
- Flanged opening if any shall be covered with blank flanges sealed with blank gasket of natural rubber or equivalent. Butt welded opening shall be closed with temporary closing covers. Internal threads shall be protected with metal plug sealed with Teflon tape (if applicable). External thread shall be protected with PVC sleeve.
- Wooden cases shall be covered with HDPE cloth from inside wooden box and the top. All the opening in Self Cleaning Strainer shall be closed properly by suitably covering to prevent foreign material entering in plate heat exchanger.

- All fabricated wooden cases & crates conform to the requirement as per table given below:

Gross Weight [Kgs.]	Board Thickness	Batton / Rafter Thickness
2000 to 9000	Min. 30 mm	Min. 35 mm
9000 to 18000	Min. 50 mm	Min. 35 mm

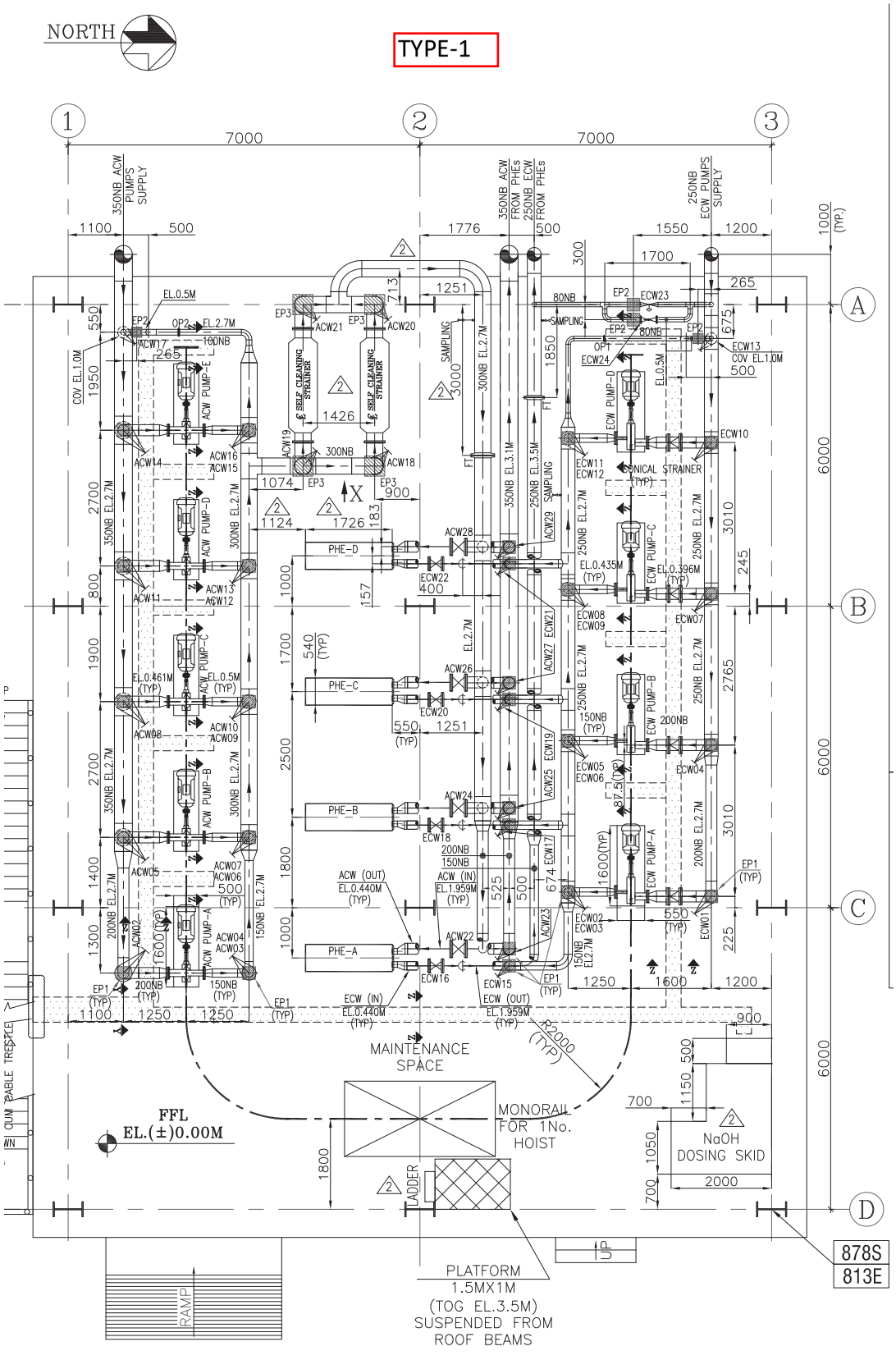
- All the equipment shall be protected for entire period of dispatch, storage and erection against corrosion, incidental damage due to vermin, sunlight, rain, high temperature, humid atmosphere, rough handling in transit and storage. All MS parts which are not painted shall be provided with coating of grease.
- Clay Desiccant or such other moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.

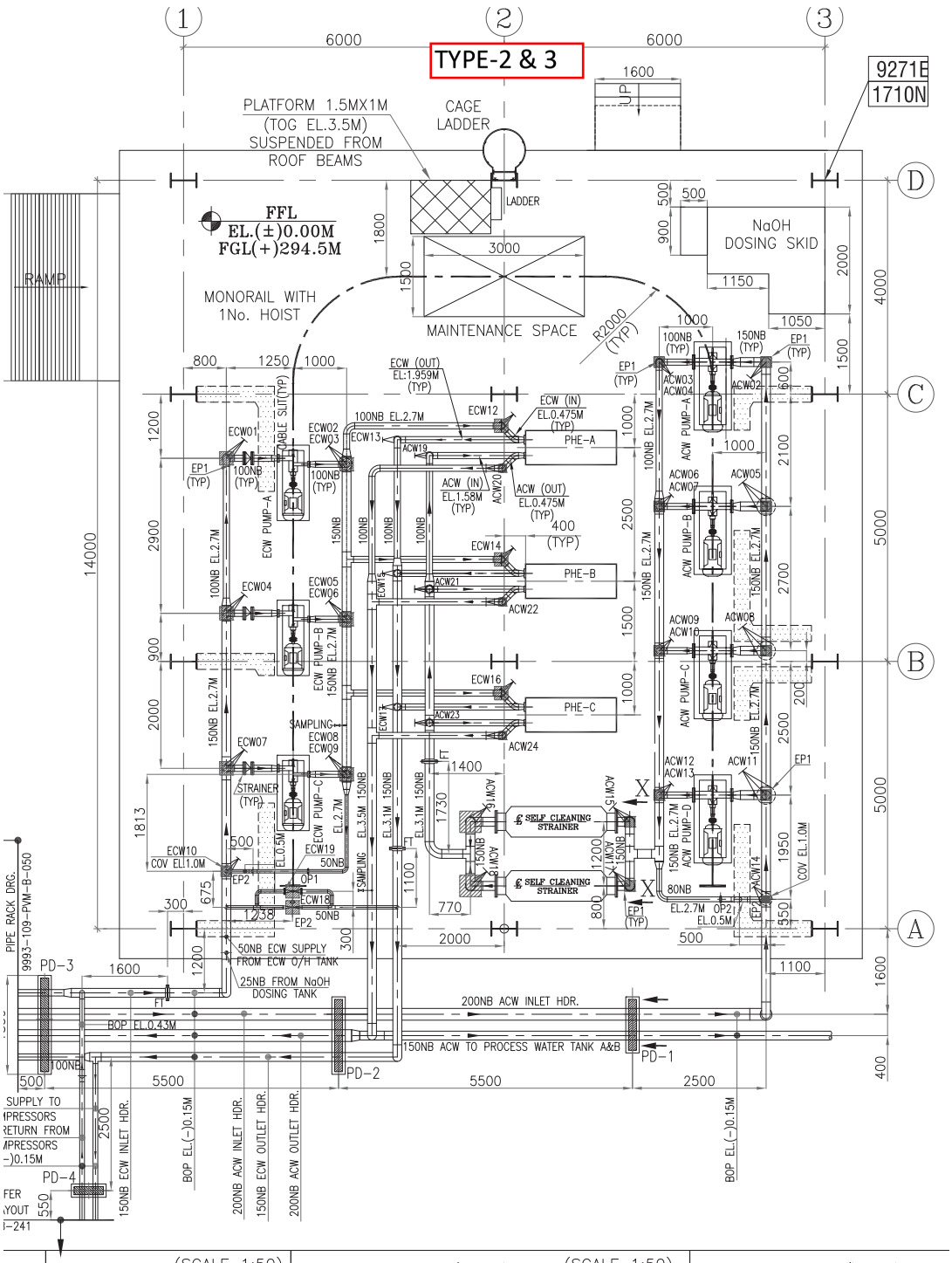
14.3 Preservation

The equipment's shall be stored under closed/open space in packed condition until installation. The packages containing loose plates and gaskets are to be protected from extreme climatic conditions.

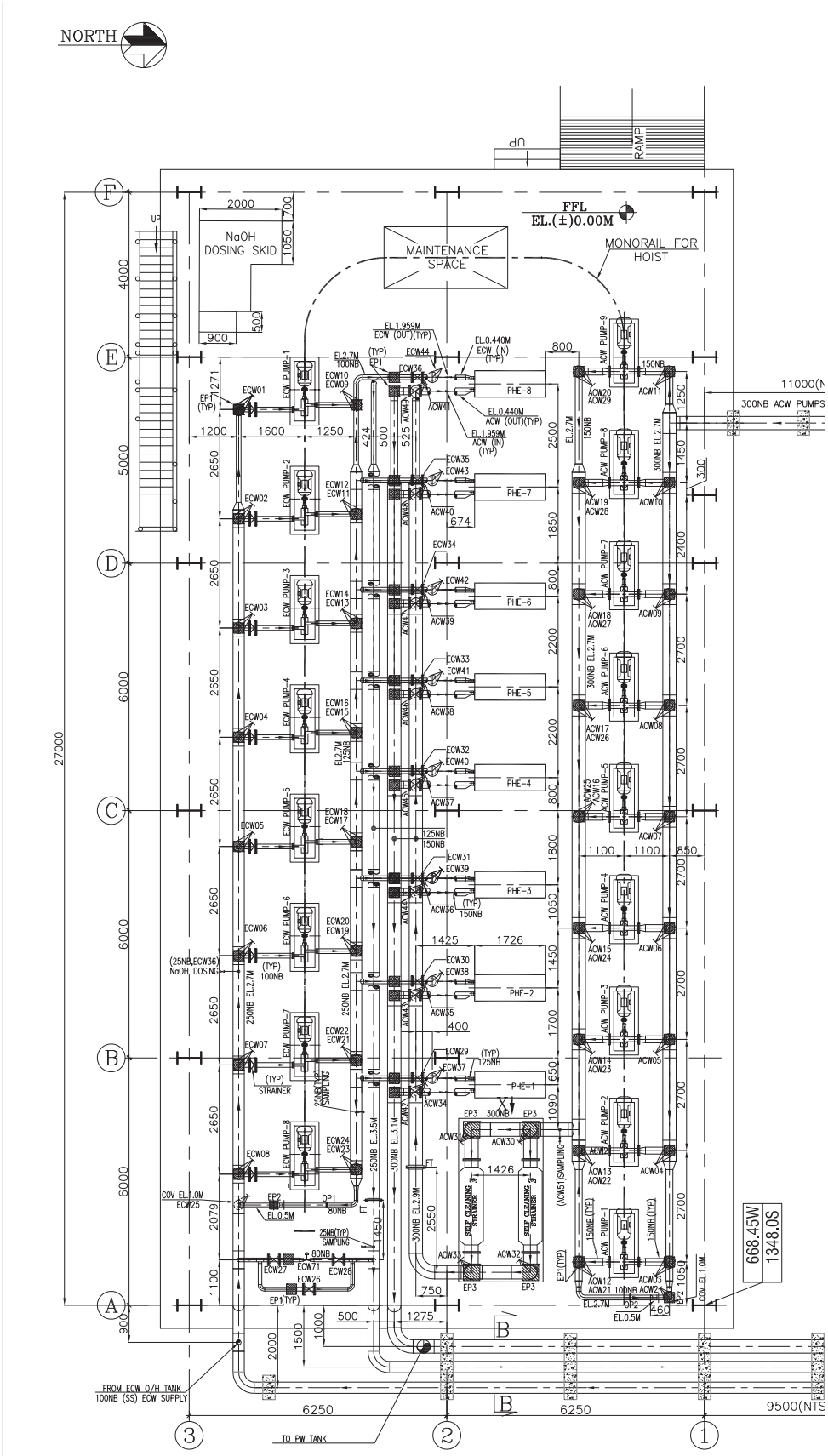
14.4 Photographs

Bidder to take photographs of all parts like SCS Shell, Screen, pumps (if any), piping, valves, instruments, actuators, panel (inside & outside) and sent to engineering department along with all inspection reports before final dispatch.

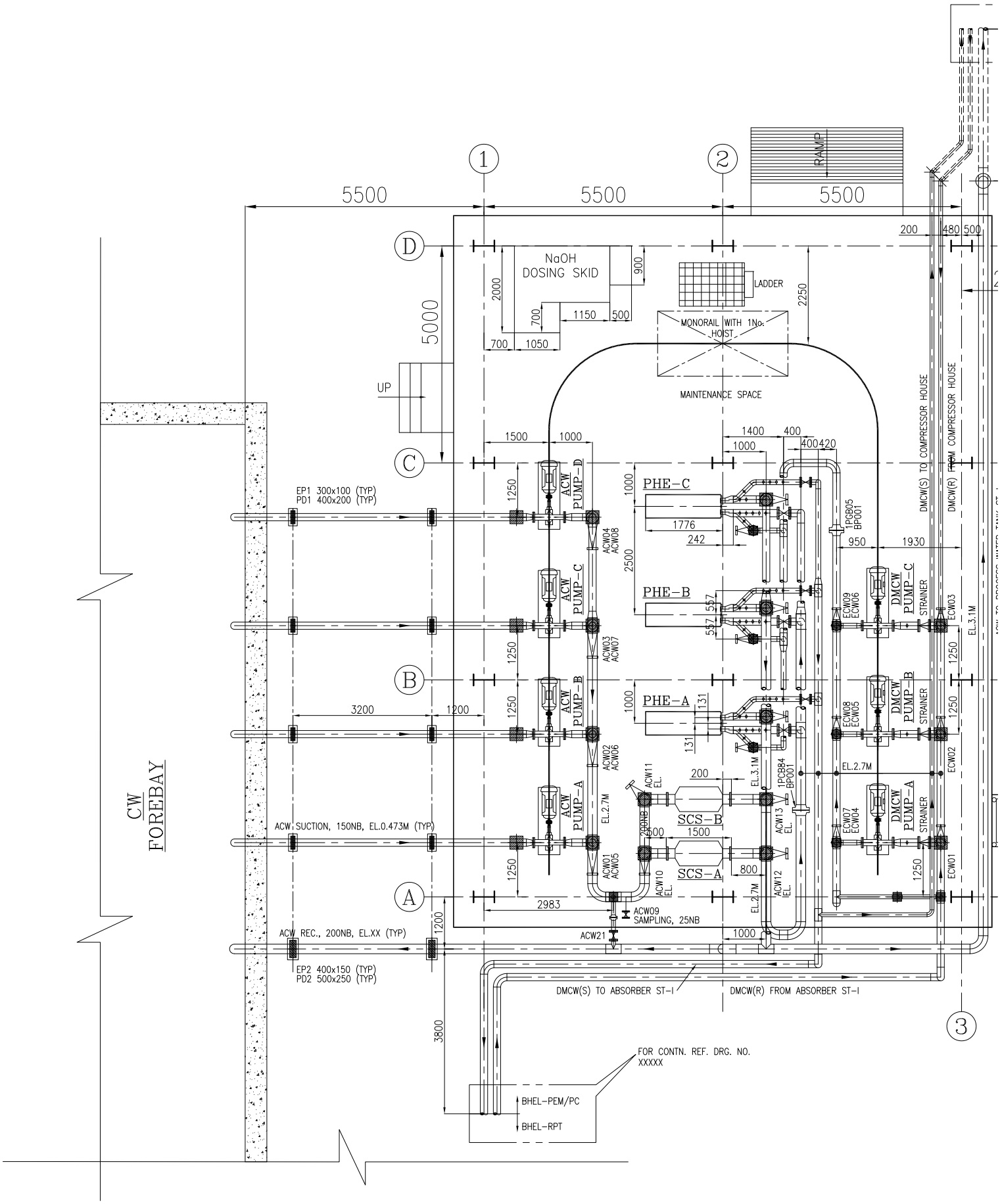

NORTH
TYPE-1
1
2
3
A
B
C
D
7000
7000
350NB ACW PUMPS SUPPLY
350NB ACW FROM PHEs
250NB ECW FROM PHEs
250NB ECW PUMPS SUPPLY
ACW PUMP-E
ACW PUMP-D
ACW PUMP-C
ACW PUMP-B
ACW PUMP-A
ECW PUMP-D
ECW PUMP-C
ECW PUMP-B
ECW PUMP-A
PHE-D
PHE-C
PHE-B
PHE-A
SELF CLEANING STRAINER
CONICAL STRAINER (TYP)
SAMPLING
FFL
EL.(±)0.00M
MAINTENANCE SPACE
MONORAIL FOR 1No. HOIST
LADDER
NaOH DOSING SKID
PLATFORM 1.5MX1M (TOG EL.3.5M) SUSPENDED FROM ROOF BEAMS
RAMP
CABLE TRESTLE
878S
813E

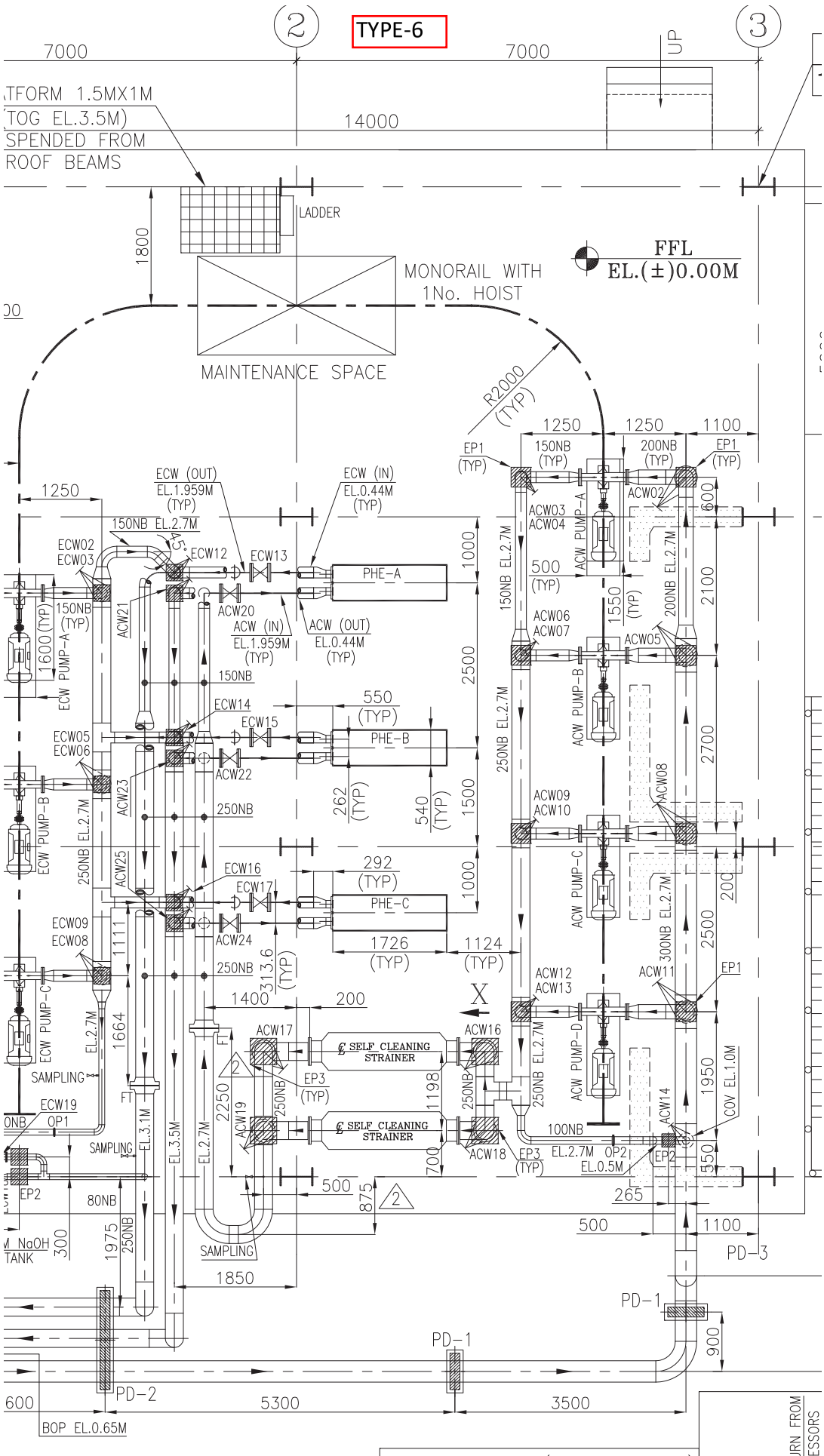

TYPE-2 & 3
9271E
1710N
PLATFORM 1.5MX1M
(TOG EL.3.5M)
SUSPENDED FROM
ROOF BEAMS
CAGE
LADDER
FFL
EL.(±)0.00M
FGL(+)294.5M
RAMP
MONORAIL WITH
1No. HOIST
MAINTENANCE SPACE
NaOH
DOSING SKID
PHE-A
PHE-B
PHE-C
ECW PUMP-A
ECW PUMP-B
ECW PUMP-C
ACW PUMP-A
ACW PUMP-B
ACW PUMP-C
ACW PUMP-D
SELF CLEANING
STRAINER
50NB ECW SUPPLY
FROM ECW O/H TANK
25NB FROM NaOH
DOSING TANK
200NB ACW INLET HDR.
150NB ACW TO PROCESS WATER TANK A&B
BOP EL.0.43M
PD-1
PD-2
PD-3
PD-4
PIPE RACK DRG.
9993-109-PVM-B-050
(SCALE 1:50)
80NB ECW RETURN FROM
IA/SA COMPRESSORS
80NB ECW SUPPLY TO
IA/SA COMPRESSORS
ISMC150
BOP EL.(−)0.15M
EL.(−)0.3M
FGL EL(−)0.5M
150NB ECW OUTLET HDR.
200NB ACW OUTLET HDR.
200NB ACW INLET HDR.
100NB ECW INLET HDR.

TYPE-4


NORTH
RAMP
UP
FFL
EL.(±)0.00M
MAINTENANCE SPACE
MONORAIL FOR HOIST
NaOH DOSING SKID
2000
1050
700
500
900
4000
5000
6000
27000
PHE-8
PHE-7
PHE-6
PHE-5
PHE-4
PHE-3
PHE-2
PHE-1
ECW PUMP-1
ECW PUMP-2
ECW PUMP-3
ECW PUMP-4
ECW PUMP-5
ECW PUMP-6
ECW PUMP-7
ECW PUMP-8
ACW PUMP-9
ACW PUMP-8
ACW PUMP-7
ACW PUMP-6
ACW PUMP-5
ACW PUMP-4
ACW PUMP-3
ACW PUMP-2
ACW PUMP-1
EL.1.959M ECW (OUT)(TYP)
EL.0.440M ECW (IN) (TYP)
EL.0.440M ACW (OUT)(TYP)
EL.1.959M ACW (IN) (TYP)
300NB ACW PUMPS
11000(N
668.45W
1348.0S
FROM ECW O/H TANK 100NB (SS) ECW SUPPLY
TO PW TANK
6250
6250
9500(NTS
1 2 3
A B C D E F

TYPE-5


1
2
3
A
B
C
D
5500
5500
5500
RAMP
NaOH
DOSING SKID
2000
900
700
1150
500
700
1050
5000
UP
LADDER
2250
MONORAIL WITH 1No.
HOIST
MAINTENANCE SPACE
200
480
500
1500
1000
1400
400
1000
400
420
EP1 300x100 (TYP)
PD1 400x200 (TYP)
ACW
PUMP-D
ACW
PUMP-C
ACW
PUMP-B
ACW
PUMP-A
1250
ACW04
ACW08
ACW03
ACW07
ACW02
ACW06
ACW01
ACW05
PHE-C
PHE-B
PHE-A
1000
2500
1776
242
557
587
131
131
950
1930
1PGB05
BP001
DMCW
PUMP-C
DMCW
PUMP-B
DMCW
PUMP-A
STRAINER
ECW09
ECW06
ECW08
ECW05
ECW07
ECW04
ECW03
ECW02
ECW01
EL.3.1M
EL.2.7M
1250
DMCW(S) TO COMPRESSOR HOUSE
DMCW(R) FROM COMPRESSOR HOUSE
3200
1200
ACW SUCTION, 150NB, EL.0.473M (TYP)
CW
FOREBAY
ACW11
EL.
200
1PCB84
BP001
ACW13
EL.
SCS-B
SCS-A
200NB
600
1500
800
ACW10
EL.
ACW12
EL.
2983
ACW09
SAMPLING, 25NB
ACW21
ACW REC., 200NB, EL.XX (TYP)
EP2 400x150 (TYP)
PD2 500x250 (TYP)
1200
1000
DMCW(S) TO ABSORBER ST-I
DMCW(R) FROM ABSORBER ST-I
3800
FOR CONTN. REF. DRG. NO.
XXXXX
BHEL-PEM/PC
BHEL-RPT


TYPE-6
2
3
7000
7000
14000
UP
TFORM 1.5MX1M
TOG EL.3.5M)
SPENDED FROM
ROOF BEAMS
LADDER
1800
MONORAIL WITH
1No. HOIST
FFL
EL.(±)0.00M
MAINTENANCE SPACE
R2000
(TYP)
1250
1250
1100
EP1
(TYP)
150NB
(TYP)
200NB
(TYP)
ECW (OUT)
EL.1.959M
(TYP)
ECW (IN)
EL.0.44M
(TYP)
150NB EL.2.7M
45°
ECW02
ECW03
ECW12
ECW13
PHE-A
ACW20
ACW (IN)
EL.1.959M
(TYP)
ACW (OUT)
EL.0.44M
(TYP)
ACW21
150NB
ECW PUMP-A
1600 (TYP)
ECW14
ECW15
PHE-B
550
(TYP)
ECW05
ECW06
ACW22
ACW23
250NB
ECW PUMP-B
250NB EL.2.7M
262
(TYP)
540
(TYP)
1500
ECW16
ECW17
PHE-C
292
(TYP)
1000
ACW24
ECW09
ECW08
ACW25
1111
1726
(TYP)
1124
(TYP)
313.6
(TYP)
250NB
ECW PUMP-C
EL.2.7M
1664
1400
200
X
ACW17
ACW16
SELF CLEANING
STRAINER
SAMPLING
EP3
(TYP)
ECW19
OP1
EL.3.1M
EL.3.5M
EL.2.7M
2250
ACW19
1198
700
ACW18
EP3
(TYP)
EL.2.7M
OP2
EL.0.5M
EP2
80NB
500
875
265
500
1100
NaOH
TANK
300
1975
250NB
SAMPLING
1850
PD-3
PD-1
PD-1
PD-2
600
5300
3500
900
BOP EL.0.65M
ACW03
ACW04
ACW PUMP-A
ACW02
600
500
(TYP)
1550
(TYP)
150NB EL.2.7M
200NB EL.2.7M
2100
ACW06
ACW07
ACW05
ACW PUMP-B
250NB EL.2.7M
2700
ACW09
ACW10
ACW08
ACW PUMP-C
2500
ACW12
ACW13
ACW11
EP1
ACW PUMP-D
250NB EL.2.7M
300NB EL.2.7M
1950
COV EL.1.0M
100NB
ACW14
550
EP2
(SCALE 1:42.5)
80NB ECW SUPPLY TO IA/SA
COMPRESSORS
ACW RETURN FROM
COMPRESSORS

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".

b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c) Supply of mandatory spares as specified in the specifications of mechanical equipments.

d) Electrical load requirement for SELF CLEANING STRAINER (all AC & DC loads at different voltage levels like 415V AC, 240 V AC, 220 V DC etc).

e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

h) Motor shall meet minimum requirement of motor specification.

i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

j) Cable BOQ worked out based on routing of cable listing provided by the vendor for " both end equipment in vendor's scope"shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Technical specification for motors.
c) Datasheets & quality plan for motors.
d) Electrical Load data format (Annexure –II)
e) BHEL cable listing format (Annexure –III)

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

ANNEXURE - I

PACKAGES: SELF CLEANING STRAINER (SCS)
SCOPE OF VENDOR: SUPPLY
PROJECT:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC Starter cum control panel (if applicable)	BHEL Vendor	BHEL BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL Vendor BHEL	 BHEL BHEL BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Cabling/ termination by BHEL.
4	Junction box for control & instrumentation cable	Vendor	BHEL	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	BHEL	Refer scope/ C&I portion of specification for scope of fibre Optical cables if used between PLC/ micro processor & DCS.
6	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
7	Cable glands and lugs for equipment supplied by Vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty copper lugs for power & control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	BHEL	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: SELF CLEANING STRAINER (SCS)
SCOPE OF VENDOR: SUPPLY
PROJECT:

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
10	Equipment grounding & lightning protection	BHEL	BHEL	
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	BHEL	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	BHEL	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Equipment layout drawings	Vendor	-	For preparation of cabling layout drawings by BHEL, vendor shall furnish Electrical equipment layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling,
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.

ANNEXURE-III

1.0	Design ambient temperature		:	50 °C
2.0	Maximum acceptable kW rating of LV motor		:	200KW *
3.0	Installation (Indoors/ Outdoors)		:	As required
4.0	Details of supply system			
	a)	Rated voltage (with variation)	:	415V ± 10%
	b)	Rated frequency (with variation)	:	50 Hz + 3 % to - 5%
	c)	Combined voltage & freq. variation	:	10% (sum of absolute values)
	d)	System fault level at rated voltage	:	50 kA for 1 sec
	e)	Short time rating for terminal boxes		
		○ 110 kW and above (Breaker Controlled)	:	50 KA for 0.25 sec.
		○ Below 110 kW (Contactor Controlled)	:	50 KA protected by HRC fuse
	f)	LV System grounding	:	Solidly
5.0	Winding & Insulation		:	Class F with temp rise limited to class B
6.0	Minimum voltage for starting (As percentage of rated voltage)		:	85% for motor ratings below 110kW 80% for motor ratings from 110kW to 200kW.
7.0	Power cables data		:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material		:	Shall be given during detailed engg.
9.0	Space heater supply (for motors >=30kw)		:	240 V, 1ϕ, 50 Hz
10.0	Rating up to which Single phase motor		:	Acceptable below 0.2 kW
11.0	Locked rotor current			
	a)	Limit as percentage of FLC	:	As per IS 12615
12.0	Makes		: BHEL/ Customer approval (Package owner to take care)	
13.0	Paint shade		:	Blue (RAL 5012) – Corrosion proof
14.0	Degree Of protection for motor/ terminal box		:	Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

i) Indoor motors - IP 54
ii) Outdoor motors - IP 55
iii) Cable box-indoor area - IP 54
iv) Cable Box-Outdoor area - IP 55

* **LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615**

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

TECHNICAL SPECIFICATION

FOR MOTORS
SUB-SECTION-II-E2

MOTORS

MOTORS

1.00.00 GENERAL REQUIREMENTS

1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.02.00 All equipment's shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

1.03.00 Contactor shall provide fully compatible electrical system, equipment's, accessories and services.

1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.05.00 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

1.06.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances for Contactors equipment and systems shall be under the Contactor scope.

1.07.00 Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows :-

i)	Indoor motors	-	IP 54
ii)	Outdoor motors	-	IP 55
iii)	Cable box-indoor area	-	IP 54
iv)	Cable box-Outdoor area	-	IP 55

2.00.00 CODES AND STANDARDS

1)	Three phase induction motors	:	IS/IEC:60034
2)	Single phase AC motors	:	IS/ IEC:60034
3)	Crane duty motors	:	IS:3177, IS/IEC:60034
4)	DC motors/generators	:	IS:4722, IS/IEC:60034
5)	Energy Efficient motors	:	IS 12615, IEC:60034-30

3.00.00 **TYPE**

3.01.00 **AC Motors:**

a) Squirrel cage induction motor suitable for direct-on-line starting.

b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be **Premium Efficiency class-IE3**, conforming to IS 12615, or IEC:60034-30.

c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.

3.02.00 DC Motors Shunt wound.

4.00.00 **RATING**

(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.

(b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.

5.00.00 **TEMPERATURE RISE**

Air cooled motors

70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.

Water cooled

80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.

6.00.00 **OPERATIONAL REQUIREMENTS**

6.01.00 **Starting Time**

6.01.01 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.

6.01.02 For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.

6.01.03 For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.

6.01.04 Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.

6.02.00 **Torque Requirements**

6.02.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

6.02.02 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

6.03.00 **Starting voltage requirement**

(a) Up to 85% of rated voltage for ratings below 110 KW

(b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW

(c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW

(d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW

(e) Up to 75 % of rated voltage for ratings above 4000KW

7.00.00 DESIGN AND CONSTRUCTIONAL FEATURES

7.01.00 Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.

7.02.00 All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below

(a) Fuel oil area : Group – IIB

(b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)

7.03.00 Winding and Insulation

(a)	Type	:	Non-hygroscopic, oil resistant, flame resistant
(b)	Starting duty	:	Two hot starts in succession, with motor initially at normal running temperature.
(c)	11kV & 3.3 kV AC motors	:	Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15.
(d)	240VAC, 415V AC & 220V DC motors	:	Thermal Class (B) or better

7.04.00 Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.

7.05.00 Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.

7.06.00 Noise level for all the motors shall be limited to 85 dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

7.07.00 In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors.

7.08.00 Motor body shall have two earthing points on opposite sides.

7.09.00 11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.

7.10.00 3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Employer shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

7.11.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.
7.12.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life.
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.15.00	The size and number of cables (for HT motors) to be intimated to the successful Contactor during detailed engineering and the Contactor shall provide terminal box suitable for the same.
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance): (a) From 50KW & upto 110KW : 11.0 (b) From 110 KW & upto 200 KW : 9.0 (c) Above 200 KW & upto 1000KW : 10.0 (d) From 1001KW & upto 4000KW : 9.0 (e) Above 4000KW : 6 to 6.5
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
10.01.01	The Contactor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Contactor shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's engineer.
10.01.02	The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contactor. The Contactor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
10.01.03	In case the Contactor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering

the type test reports to the Employer for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the Contactor.

10.01.04 Further the Contactor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.

10.01.05 **LIST OF TYPE TESTS TO BE CONDUCTED**

The following type tests shall be conducted on each type and rating of HT motor

(a) No load saturation and loss curves upto approximately 115% of rated voltage

(b) Measurement of noise at no load.

(c) Momentary excess torque test (subject to test bed constraint).

(d) Full load test(subject to test bed constraint)

(e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp.,coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

10.01.06 **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of HT motor

(a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

(b) Terminal box-fault level withstand test for each type of terminal box of HT motors only.

(c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15

(d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

10.02.00 **LT Motors**

10.02.01 LT Motors supplied shall be of type tested design. During detailed engineering, the Contactor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last *ten* years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

10.02.02 However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.

10.02.03 **LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED**

The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only

1. Measurement of resistance of windings of stator and wound rotor.
2. No load test at rated voltage to determine input current power and speed
3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
4. Full load test to determine efficiency power factor and slip
5. Temperature rise test
6. Momentary excess torque test.
7. High voltage test
8. Test for vibration severity of motor.
9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)

10. Test for degree of protection and

11. Overspeed test.

12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

10.03.00 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

10.04.00 The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW of	Minimum distance between centre stud and gland plate in mm
UP to 3 KW	**As per manufacturer's practice.**
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

a minimum 600mm clear walk way and shall have maintenance platforms as required. The bottom of the steel supporting structure shall be generally at 3.0M above the grade level except for rail/road crossings where it shall be at 8.0M above grade level. Tap offs from the overhead cable trestle can be through shallow trenches with prior approval of the Employer. Directly buried cable, if essential, shall not have concentration of more than 4 cables on one route.

b) Cable trenches shall be provided only in Switchgear/MCC rooms.

c) Cables shall not be routed through the conveyor galleries except for the equipment located in the conveyor galleries for a particular conveyor i.e. protection switches, receptacles etc.

d) Cables for PCS and BSS shall be routed along the conveyors through GI conduits.

3.03.00 **Pipes, Fittings & Accessories**

3.03.01 Pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples etc.) The size of the pipe shall be selected on the basis of maximum 40% fill criteria

3.03.02 GI Pipes shall be of medium duty as per IS: 1239

3.03.03 Duct banks shall be High Density PE pipes encased in PCC (10% spare of each size, subject to minimum one) with suitable water-proof manholes.

3.03.04 Hume pipes shall be NP3 type as per IS 458.

3.03.05 TERNE Coated Flexible Steel Conduits shall be water proof and rust proof made of heat resistant lead coated steel. Conduit diameter shall be uniform throughout its length. Internal surface of the conduit shall be free from burrs and sharp edges. Conduits shall be complete with necessary accessories for proper termination of the conduit with junction boxes and lighting fixtures

3.03.06 HDPE pipes and conduits shall be PE-80, PN-10 type as per IS 4984/IS 8008 part-I.

3.04.00 **Junction Boxes**

3.04.01 Junction box shall be made of Fire retardant material. Material of JB shall be Thermoplastic or thermosetting or FRP type. The box shall be provided with the terminal blocks, mounting bracket and screws etc. The cable entry shall be through galvanized steel conduits of suitable diameter. The JB shall have suitable for installing glands of suitable size on the bottom of the box. The JB shall be suitable for surface mounting on ceiling/structures. The JB shall be of grey color RAL 7035. All the metal parts shall be corrosion protected. Junction box surface should be such that it is free from crazings, blisterings, wrinkling, colour blots/striations. There should not be any mending or repair of surface. JB's will be provided with captive screws so that screws don't fall off when cover is opened. JB's mounting brackets

should be of powder coated MS. Type test reports for the following tests shall be furnished:-

(a) Impact resistance for impact energy of 2 Joules (IK07)as per BS EN50102

(b) Thermal ageing at 70deg C for 96 hours as per IEC60068-2-2Bb.

(c) Class of protection shall be IP 55.

(d) HV test.

3.04.02 Terminal blocks shall be 1100V grade, of suitable current rating, made up of unbreakable polyamide 6.6 grade. The terminals shall be screw type or screw-less (spring loaded) / cage clamp type with lugs. Marking on terminal strips shall correspond to the terminal numbering in wiring diagrams. All metal parts shall be of non-ferrous material. In case of screw type terminals the screw shall be captive, preferably with screw locking design. All terminal blocks shall be suitable for terminating on each side the required cables/wire size. All internal wiring shall be of cu. Conductor PVC wire.

3.05.00 **Terminations & Straight Through Joints**

3.05.01 Termination and jointing kits for 33kV, 11 kV, 6.6 KV and 3.3 kV grade XLPE insulated cables shall be of proven design and make which have already been extensively used and type tested. Termination kits and jointing kits shall be Pre-moulded type or heat shrinkable type. Further Cold shrinkable type termination and jointing kits are also acceptable. The Cold shrinkable type kits shall be type tested as per relevant standards. Calculation to withstand the required fault level shall also be furnished in case of cold shrinkable type kits. 33 kV, 11 kV, 6.6 KV and 3.3kV grade joints and terminations shall be type tested and Type test reports as per IS:13573 Part-II and IEC60502 shall be furnished. Also, heat shrink material shall comply with requirements of ESI 09-13 (external tests). Critical components used in cable accessories shall be of tested and proven quality as per relevant product specification/ESI specification. Cable joints and terminations should be with FRLS properties as per IEC 60754-1&2. Kit contents shall be supplied from the same source as were used for type testing. The kit shall be complete with the tinned copper solderless crimping type cable lugs & ferrule or mechanical connectors (wherein bolts are tightened that shear off at an appropriate torque) as per DIN standard suitable for aluminium compacted conductor cables. (Tender drg. no 0000-211-POE –A-51-RA of cable lug attached at the end of this chapter).

3.05.02 Straight through joint and termination shall be capable of withstanding the fault level of 21 KA for 0.12 Sec. with dynamic peak of 52 KA for 33 KV system & of 40 kA for 0.12 sec with a dynamic peak of 100 kA for 11 kV, 6.6 KV & 3.3 KV system. Straight through joints shall have provisions for shield connection and earthing wherever required and complete with all accessories and consumables suitable for storage without deterioration at a temperature of 50 deg. C with shelf life of more than five years. 1.1 kV grade straight through joints shall also be of proven design

3.05.03 1.1 KV grade Straight Through Joint shall be of proven design.

3.06.00 **Cable glands**

3.06.01 Cable shall be terminated using double compression type cable glands. Testing requirements of Cable glands shall conform to BS:6121 and gland shall be of robust construction capable of clamping cable and cable armour (for armoured cables) firmly without injury to insulation. Cable glands shall be made of heavy duty brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 micron. All washers and hardware shall also be made of brass with nickel chrome plating Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall be suitable for the sizes of cable supplied/erected.

3.07.00 **Cable lugs/ferrules**

3.07.01 Cable lugs/ferrules shall be solderless crimping type suitable for power and control cables as per the DIN 46239. Aluminium solderless crimping lugs/ ferrules shall be used for Aluminium cables and Copper lugs/ferrules shall be used for Copper cables. Bimetallic washers or bimetallic type lugs shall be used for bimetallic connections.

Crimping tool for crimping (from 1.5sqmm cable to 630sqmm cables) above mentioned lugs shall be of Hexagonal Type crimp profile, with suitable die of crimp match code.
Characteristics of crimping tool:

1) To should generate enough pressure to pass pull out test as per IEC 61238-1. Relevant type test to be produced for the sizes specified in the tender.
2) Tool die shall be replaceable for assorted sizes and crimp code to be mentioned on both part the die.
3) Tool should be compliant of testing according to IEC, UL and GS standards.

Tool shall have features such as:

- Auto retraction system
- Manual retraction stop.
- Feedback signals for improper pressure
- Better battery capacity and with status display
- Flexible and rotating head for easy crimping.

3.08.00 **Trefoil clamps**

3.08.01 Trefoil clamps for single core cables shall be pressure die cast aluminum or fibre glass or nylon and shall include necessary fixing accessories like G.I. nuts, bolts, washers, etc. Trefoil clamps shall have adequate mechanical strength, when installed at 1 mtr intervals, to withstand the forces generated by the peak value of maximum system short circuit current.

3.09.00 **Cable Clamps & Ties**

VOLUME: II-F

SECTION-XIII

CABLES

1.00.00 SCOPE OF SUPPLY

1.01.00 Power and Control Cables shall cover the entire requirement of FGD Package. The cables shall be furnished in accordance with this specification and Annexure.

Other cables including special cables, if any, which are necessary as per proven engineering practice for satisfactory & trouble-free operation of the entire cable system of the FGD plant shall also be within the scope of supply. These shall include all such cables for electrical integral with mechanical equipment systems and sub-systems.

1.02.00 Cable shall be furnished in accordance with this specification and the following annexures:

a)	H.V. Power cables	:	Annexure – I
b)	L.V. Power Cables	:	Annexure – II
c)	Control Cables	:	Annexure – III
d)	Standard Cable Sizes	:	Annexure – IV

1.03.00 All relevant drawings, data and instruction manuals

2.00.00 CODES & STANDARDS

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

2.02.00 Cable and material 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.

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

3.00.00 DESIGN CRITERIA

3.01.00 The Cables shall be used for connection of power and control circuits of the auxiliary electrical systems.

3.02.00 Cables will be generally laid on ladder type trays or drawn through rigid PVC/GI /HDPE pipe/conduits or directly buried in ground depending on layout requirement.

3.03.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and / or this specification which one is more stringent.

3.04.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

3.05.00 The outer sheath of power and control cables shall have rodent and termite repulsion treatment.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 General Description

All Cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexures to this Specification.

4.02.00 Drum Length and Tolerance

The cables shall be supplied in non-returnable packing steel drum for 3.3/11kV power cables, wooden drums for 415/240V power and control cables, each containing minimum 500meters length of larger sizes of cable unless specifically asked for. For smaller sizes of cables, each drum shall contain 1000 meters length of cable. Allowable tolerance on individual drum length is ±5%.

4.03.00 Total Quantity Variation

Total supplied quantity shall not vary by more than ± 2-1/2% of total quantity for ordered length for all types of cables.

4.04.00 Non-Standard Length

Owner may accept non-standard lengths up to 5% of the total ordered quantity. However, the Bidder shall be required to obtain Owner's approval before packing the Cables on drums. Non-standard lengths shall not be less than 100 meters in any case.

4.05.00 Cable identification

Cable identification shall be provided by embossing on every meter on the outer sheath the following:

a) Manufacturer’s name or trade mark

b) Voltage grade

c) Year of manufacture

d) Type of insulation, e.g. XLPE/PVC/HR85 etc.

e) No. of core and size of cables.

f) Type of improved fire performance, e.g. FR/FR-LSH

g) IS number

4.06.00 **Packing**

4.06.01 Cables shall be supplied in non-returnable drums. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage.

4.06.02 Cable shall be wound and packed on drums in such a manner that it shall be properly sealed and firmly secured to the drum. The ends of each length shall be sealed before shipment.

4.06.03 The cable drums should carry the following details in printed form:

a) Manufacturer's name or trademark

b) Type of cable & voltage grade

c) Year of manufacture

d) Type of insulation e.g. XLPE

e) No. of core and size of cables

f) Cable code

g) Length of cable on drum

h) No. of length on drum, if more than one

i) Direction of rotation, by arrow

j) Approx. gross mass.

k) IS number and ISI mark

4.07.00 **Selection Criteria**

4.07.01 In cable sizing the following are to be taken into consideration.

a) Short circuit current and duration

b) Continuous current.

c) Installation conditions.

d) Voltage drop under normal running and starting condition.

e) Grouping factor and laying method.

4.07.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes instead of using too many types.

4.07.03 The standard cable sizes, capacities, derating factors, etc. as given in IS / IEC shall be generally followed.

4.07.04 a) For breaker protected circuits minimum size shall be determined by short circuit rating and system short circuit current withstand time shall be considered as 0.2 secs. System short circuit current withstand time for Incomers and Tie feeders shall be considered as 1 sec.

b) For motor circuits the selection of size shall be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.

4.07.05 For fuse protected circuit, the conductor size shall depend on full load current subject to voltage drop not exceeding 3%. For practical purposes, the minimum size chosen is as below:

a) Aluminium : 16 Sq. mm.

b) Copper : 2.5 Sq. mm.

All drives of small rating where terminations with 16 Sq. mm. cables are not feasible, shall have copper cable.

4.07.06 Multicore control cables shall generally have spare conductor (s) in accordance with the following chart:

Conductors required	Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C
7 to 8	1-9/C
9 or 10	1-12/C
Above 10	Two or more of above cables

4.07.07 Separate cables for each type of following services / functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

a) Power.

b) Control, interlock and indication.

c) Metering and measuring.

d) Alarm and annunciation.

e) C.T. Cables.

f) V.T. Cables.

4.08.00 Selected sizes of power and control cables are given in Annexure-VI.

5.00.00 TESTS

5.01.00 Shop Tests

The Cables shall be subject to shop tests in accordance relevant IS/IEC standards to prove the design and general qualities of the Cables as below: -

5.01.01 Routine tests on each drum of cables.

The following minimum tests shall be carried out as routine tests on each and every drum length of cable, as per IS 7098 (Part 2) / 1985, in addition to other tests.

a) High Voltage Test

5.01.02 Acceptance Test

The following test shall be carried out as Acceptance Test in the presence of Owner's Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 number of drums or less shall be selected at random sampling basis in each lot for the Acceptance Tests which shall be carried out at manufacturer's/supplier's cost:-

a) High Voltage Test
b) Conductor Resistance Test
c) Tensile / wrapping test.
d) Partial discharge test (In screened cables).
e) Insulation Resistance/Volume resistivity test
f) Measurement of thickness of insulation and sheath and other dimensions
g) Tensile strength & elongation at break for insulation & sheath.
h) Hot set test on XLPE insulation

i) Flammability test as per Swedish standard SS:424-15-75 Class-F-3 (Swedish Chimney test)/IS:10810
j) Acid gas generation test as per IEC-754-1/IS:10810.
k) Smoke density test as per ASTM-D-2843/1977/IS:10810
l) Oxygen index test as per ASTM-D 2863/1977/IS:10810
m) Temp. index test as per ASTM-2863/77/IS:10810
n) Test for Rodent and termite repulsion property

5.01.03 Type tests on each type of cable, size and batch inclusive of measurement of armour D.C. resistance of power cables as per relevant IS.

5.02.00 **Additional Tests**

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance (Type FRLSH):

5.02.01 Oxygen index test

The Oxygen index shall not be less than 29.

5.02.02 Temperature Index Test

The measured value of temperature index shall be 21 at a temperature of 250°C

5.02.03 Flame Retardance test on single cable and on bunched cables

After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly.

5.02.04 Halogen acid gas evolution test

The level of HCL evolved shall not exceed 20 per cent by weight

5.02.05 Smoke density test

The cables shall meet the requirements of light transmission of minimum 40% after the test.

5.02.06 **Test for rodent & termite repulsion property**

The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium

sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.

5.03.00 **Test Witness**

Tests shall be performed in presence of Owner/'s representative if so desired by the Owner. The Contractor shall give at least thirty (30) days' advance notice of the date when the tests are to be carried out.

5.04.00 **Test Certificates**

5.04.01 Certified reports of all the tests carried out at the works shall be furnished for approval of the Owner.

5.04.02 Test reports shall be completed with all details and shall also contain IS specified limit values, wherever applicable, to facilitate review.

5.04.03 The cables shall be dispatched from works only after receipt of Owner/Purchaser's written approval of the test reports.

6.00.00 DRAWINGS, DATA & MANUALS

6.01.00 **To be furnished after award of contract**

a) Manufacturer's catalogues giving cable construction details and characteristics.

b) Cable current ratings for different types of installation, inclusive of derating factors for ambient temperature, grouping etc.

c) Write-up on Manufacturer's recommended method of splicing, jointing, termination etc. of the cables.

d) Type test report on all specified cables.

e) Proposal Data as per Annexure.

f) Confirmed cable data

g) Test reports

6.02.00 **To be submitted for Owner/Purchaser's Approval and Distribution**

6.02.01 Guaranteed Technical Particulars.

6.02.02 Quality assurance plan.

6.02.03 Shop Test reports.

6.02.04 Instruction manuals.

6.02.05 The manual shall clearly indicate method of laying, termination, check-ups and tests to be carried out before commissioning.

6.03.00 The bidder may note that the drawings, data and manuals listed herein are minimum requirement only. The bidder shall ensure that all other necessary write-up, information, etc required to fully describe the cable are to be submitted with the bid.

ANNEXURE-II

L.V. POWER CABLES 1100 V GRADE

1100 V grade, 90ºC continuous rating under normal condition and 250°C short time rating under short circuit condition XLPE insulated FRLSH sheathed heavy duty, power cable conforming to following requirement and in line with IS 7098, IS 8130, IS 5831 and IS 3975.

1.1	Conductor	:	Stranded and compacted plain aluminium of grade H2 and Class 2/stranded, high conductivity annealed plain copper generally conforming to IS: 8130.
1.2	Insulation	:	Extruded Cross-Linked polyethylene (XLPE) conforming to IS:7098 (Part-3)
1.3	Core Identification	:	By color coding
1.4	Inner Sheath	:	Extruded FRLSH PVC compound conforming to type ST2 of IS: 5831 for multicore cable. Single core cables shall have no inner sheath.
1.5	Armour	:	Galvanised single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminium single round wire conforming to H4 grade for single core cables.
1.6	Overall Sheath	:	Extruded FRLSH PVC compound conforming to type ST2 of IS: 5831.
1.7	Drum	:	Conforming to IS-10418 (Wooden drum)

ANNEXURE-III

CONTROL CABLES

1.0 1100 V grade 70ºC continuous rating under normal condition and 160°C short time rating under short circuit condition PVC insulated FRLSH sheathed control cable conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.

1.1	Conductor	:	Stranded, non-compacted & circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
1.2	Insulation	:	Extruded PVC compound conforming to type A of IS: 5831.
1.3	Core Identification	:	By color coding and numbering at interval of 100mm or less
1.4	Inner sheath	:	Extruded FRLSH PVC compound conforming to type ST1 of IS: 5831 for multicore cables. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST1.
1.5	Armour	:	Galvanized single round steel wire for twin and Multi-core cables.
1.6	Overall sheath	:	Extruded FRLSH PVC compound conforming to type ST1 of IS: 5831.
1.7	Drum	:	Conforming to IS: 10418 (Wooden drum)

ANNEXURE-IV

STANDARD CABLE SIZES (Only for Reference)

Sl. No.	Cable Size	Conductor	Insulation
1.0	**HT Cables**		
1.1	1 core 70 Sq. mm	AL	XLPE (FRLSH)
1.2	3 core 150 Sq. mm	AL	XLPE (FRLSH)
1.3	3 core 185 Sq. mm	AL	XLPE (FRLSH)
1.4	3 core 300 Sq. mm	AL	XLPE (FRLSH)
1.5	1 core 500 Sq. mm	AL	XLPE (FRLSH)
1.6	1 core 630 Sq. mm	AL	XLPE (FRLSH)
2.0	**LT Power Cables**		
2.1	2 core 2.5 Sq. mm.	CU	XLPE (FRLSH)
2.2	3 core 2.5 Sq. mm.	CU	XLPE (FRLSH)
2.3	4 core 4 Sq. mm.	CU	XLPE (FRLSH)
2.4	2 core 10 Sq. mm.	AL	XLPE (FRLSH)
2.5	3 core 10 Sq. mm.	AL	XLPE (FRLSH)
2.6	2 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.7	3 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.8	4 core 16 Sq. mm.	AL	XLPE (FRLSH)
2.9	3 core 25 Sq. mm.	AL	XLPE (FRLSH)
2.10	2 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.11	3 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.12	4 core 35 Sq. mm.	AL	XLPE (FRLSH)
2.13	3 core 50 Sq. mm.	AL	XLPE (FRLSH)
2.14	3 core 70 Sq. mm.	AL	XLPE (FRLSH)
2.15	4 core 70 Sq. mm.	AL	XLPE (FRLSH)
2.16	3 core 95 Sq. mm.	AL	XLPE (FRLSH)
2.17	3½ core 95 Sq. mm.	AL	XLPE (FRLSH)
2.18	3 core 150 Sq. mm.	AL	XLPE (FRLSH)
2.19	3 core 185 Sq. mm.	AL	XLPE (FRLSH)
2.20	3½ core 185 Sq. mm.	AL	XLPE (FRLSH)

Sl. No.	Cable Size	Conductor	Insulation
2.21	3 core 240 Sq. mm.	AL	XLPE (FRLSH)
2.22	3½ core 240 Sq. mm.	AL	XLPE (FRLSH)
2.23	3 core 300 Sq. mm.	AL	XLPE (FRLSH)
2.24	3½ core 300 Sq. mm.	AL	XLPE (FRLSH)
2.25	1 core 630 Sq. mm.	AL	XLPE (FRLSH)
3.0	**Control Cable**		
3.1	2 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.2	3 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.3	5 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.4	7 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.5	12 core 2.5 Sq. mm.	CU	PVC (FRLSH)
4.6	16 core 2.5 Sq. mm.	CU	PVC (FRLSH)
3.7	19 core 2.5 Sq. mm.	CU	PVC (FRLSH)
4.0	**Cables For Electronic Equipment Grounding**		
4.1	1 core 35 Sq. mm.	CU	HR-PVC/XLPE (FRLSH)
4.2	1 core 150 Sq. mm.	CU	HR-PVC/XLPE (FRLSH)

ANNEXURE - A

NOTES AND DETAILS FOR CABLING SYSTEM

1.00.00 GENERAL

1.01.00 These notes and details shall be read and construed in conjunction with Specification and the drawings meant for cable tray details and supporting arrangements in Trench, Racks etc., enclosed elsewhere. In case of conflict between these notes and drawings, the latter shall prevail.

1.02.00 The Cabling System installation work shall conform to the requirements of the latest revisions of the following standards/codes

a) Indian Electricity Rules, 1956, with up to date amendment.

b) I.S. Code of Practice

2.00.00 CABLE ROUTING/LAYING

2.01.01 Cables shall generally be laid on ladder type cable trays either in trenches or overhead supported from building steel/structures except in some cases cables may have to be laid underground and for short runs in conduits for protection or crossing.

2.01.02 For interplant connections, the cables may be routed through an overhead cable bridge or cable trenches/tunnels selection being dependent on site constraints. Directly buried cable shall be avoided as far as possible. Owner's prior approval shall be taken for exceptional cases, where buried cables cannot be avoided.

2.01.03 For underground crossing of railways, roads etc. hume pipes shall be used and shall be laid at a depth of minimum 1000 mm such that cables shall not be damaged.

2.01.04 The cable racks in dust prone areas shall be supported from available structure in vertical configuration with suitable cover to avoid deposition of lignite dust as far as practicable.

2.01.05 Different voltage grade cables shall be laid in separate trays when trays are arranged in tiers. Power cables shall be on top trays and Control/Instrumentation cables on bottom trays, and it is recommended that trays for cables of different voltage levels be stacked in descending order with higher voltage level above.

2.01.06 Cables for redundant equipment/system shall be run in separate trays in separate route.

2.01.07 Cables from two different services viz. supply from station board and supply from unit board shall be fully segregated to prevent simultaneous damage due to fire in one of the services.

2.01.08 Low level signal cables and other special Instrumentation and Control cables shall run in separate trays. In general, a minimum of 1500 mm clearance shall be maintained between these cables and noise generating equipment (large motors, generators, transformers etc.).

2.01.09 The cable spreaders of each unit shall be compartmentalized by provision of fire proof partition wall.

2.01.10 The floor of the cable spreader rooms shall have to be made water proof so that water does not percolate to lower levels in the event of fire fighting operations. Adequate arrangement for efficient drainage of water shall be provided. The cable raceways should also be suitably curved to avoid water entry through this place.

2.02.00 **Cable Trays/Supports**

2.02.01 Cable trays and covers shall be pre-fabricated type, constructed from minimum 14 SWG sheet steel for trays and 16 SWG for covers and hot-dip galvanized after fabrication.

2.02.02 Cable tray supports shall be cantilever type for each installation. All supports and hardware shall be hot-dip galvanized. Support shall be fixed with bolts and no welding shall be done on the galvanized parts.

2.02.03 Standard cable tray width shall be 600 mm. However, trays with 450, and 300, 150 mm width may be used in some places considering the requirement and space restrictions. For instrumentation and control purpose, some perforated type cable trays of width 150 and/or 100mm may be used particularly in low space area and 600, 450, 300 mm perforated trays may be used depending on site requirement.

2.02.04 Cable trays shall be ladder type with 250 mm rung spacing, 100 mm depth and rung width not less than 50 mm.

2.02.05 All weld for cable tray supports shall have a minimum throat thickness of 6 mm.

2.02.06 Cable trays in areas subjected to excessive lignite dust, or mechanical damage shall have hot-dip galvanised sheet metal tray cover installed on front tray in vertical run and inverted `V' type on upper tray in horizontal run.

Where covers are used on trays containing power cables, consideration should be given to ventilation requirements. Areas where corrosive chemicals are likely to be handled, cable tray and covers shall be epoxy painted.

2.03.00 **Conduits**

2.03.01 Conduits shall be rigid steel coated type; minimum size of conduit shall be limited to 19mm.

2.03.02 Steel conduits with interior coating of silicon epoxy ester for ease of wire pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanized. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS: 9537 Part-II. In chemical handling areas, Battery room etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion.

2.03.03 Conduit runs shall be supported at an interval of 750 mm for vertical run and 1000 mm for horizontal run.

2.03.04 Conduits shall be sized so that conduit fill (ratio of total cable area to conduit area) shall not exceed the following:

One Cable	:	53%
Two Cable	:	31%
Three Cables & Up	:	40%

2.03.05 Conduit runs shall be provided with necessary bends as required.

2.04.00 **Installation**

2.04.01 The Bidder shall install, terminate and connect up all cables and conduits with supporting arrangements as per drawings, cable schedules and interconnection chart/drawings.

2.04.02 The HV power cables of 11 KV/3.3 KV shall be laid in trays or racks as follows:

a) In single layer only.

b) 3 core cables to be laid giving one diameter gap of the largest diameter adjacent cable.

c) Single core cables to be laid in trefoil formation with a spacing equal to diameter of the trefoils.

2.04.03 1100V grade power cables shall be laid in single layer in trays.

2.04.04 1100V grade power cable shall be laid giving one diameter gap of the largest diameter adjacent cable.

2.04.05 Control and Instrumentation cables can be laid up to a maximum of three layers in each tray.

2.04.06 The trays shall be run with a vertical spacing of 300 mm for overhead cable trays as well as inside cable trenches. A minimum of 225 mm clearance shall be provided between the top of tray and beams, cold piping, 500 mm clearance for hot piping/object to facilitate installation of cables in tray.

5.05.02 Components shall be pre-moulded type, taped type or heat-shrinkable type. 11kV, 6.6kV and 3.3kV grade joints and terminations shall be type tested as per IS: 13573.

5.05.03 Kits shall be complete with the alumunium solderless crimping type cable lugs and ferrule as per DIN standard.

5.06.00 **Cable Glands**

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS 6121 or to EN 50262. Ingress Protection rating for cable glands with seal, when offered conforming to EN 50262, shall be minimum IP 66 in line with BS. Cable glands shall be made of tinned brass gland, double compression type complete with necessary armour clamp and tapered washer, etc. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall match with the sizes of different H.V./L.V./Control cables supplied/erected.

5.07.00 **Cable Lugs**

All cable lugs shall be Cd plated copper. Cable lugs shall be suitable for termination of different cross-sections of H.V./L.V./Control/Instrumentation cables and shall be of following types :

i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.

ii) Copper tubular terminal end for solderless crimping to copper conductors.

Solderless crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type/U type to suit the terminals provided in the panels.

5.08.00 **Cable Clamps and Straps**

5.08.01 Trefoil clamps for single core cables shall be pressure die-cast aluminium or fibre glass or nylon with necessary G I fasteners. Trefoil clamps shall have adequate mechanical strength to forces generated by peak value of maximum system short circuit current.

5.08.02 Cable clamps required for multicore cables on vertical run shall be made up of 25x3mm size aluminium strip. For clamping the multicore cables, self-

ii) Heat Shrinkable sleeve type for HV & MV cables and LV power cables. However terminating kits for HV & MV cables shall be of heat shrinkable type of make with specific approval of Purchaser.

e) For outdoor installations, weather shields/sealing ends and any other accessories required shall also form part of the kit.

f) The straight through jointing kits shall be suitable for underground installation with uncontrolled backfill and possibility of flooding by water. Straight through joints shall be used for LV power cable sizes of 70sqmm and above. The jointing kit shall be one of the following types: -

i) 'TAPEX' of M-seal make or equivalent for LV power cables
ii) Heat Shrinkable sleeve type for HV & MV cables and LV power cables. However straight through joints for HV & MV cables and LV power cables shall be of heat shrinkable type of make with specific approval of Purchaser.

5.29.02 Raceway & Conduit

The design and specifications for the raceway and conduit systems used in supporting and protecting electrical cable shall be in accordance with the provisions of the appropriate codes and standards.

5.30.00 **Conduit**

5.30.01 Conduit shall be used to protect unarmoured conductors routed to individual devices and where the quantity of cable does not economically justify the use of cable tray.

5.30.02 Rigid conduit shall be used for hazardous and outdoor areas.

5.30.03 Galvanized rigid steel conduit shall be used for all conduit encased in concrete and all exposed conduit.

5.30.04 All conduits cast in concrete shall be routed in exposed runs parallel or perpendicular to dominant surfaces with right-angle turns made of symmetrical bends or fittings. Conduit shall be routed at least 150mm from the insulated surfaces of hot water, steam pipes, and other hot surfaces. Where conduit must be routed parallel to hot surfaces, special high temperature cables shall be used.

5.31.00 **Duct Banks & Manholes**

5.31.01 All underground duct banks shall consist of plastic conduit encased in reinforced concrete. The minimum nominal diameter/hume pipes of the plastic ducts shall be 125mm. A 75mm galvanized steel conduit shall also be installed where required for digital and analog low-level circuits requiring noise immunity from adjacent power circuits.

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C &I)

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TECHNICAL SPECIFICATION
(CONTROL AND INSTRUMENTATION)
FOR
SCS SYSTEM

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INDEX

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SPECIFIC C&I TECHNICAL REQUIREMENT FOR SCS

	NTPC FGD PACKAGES **LOT - 1A, 2 & 3**	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) FOR SCS SYSTEM	

Specific Technical Requirements (C&I):

1.0 SCS system shall be operated from FGD-DCS (DCS-BHEL Scope of supply) through operator work stations.

2.0 Bidder to provide local control panel(LCP)/starter panel for SCS system. This LCP/starter panel will act as interface between the FGD-DCS and the field devices for commands & feedbacks.
In addition, LCP/starter panel shall have the provision of command (start/stop) & feedback interface with plant FGD-DCS

3.0 Bidder to supply all the instruments (DPT, DPG etc.) required for the package along with necessary fittings, accessories and valve manifold etc. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments.

4.0 All the Electronic Transmitter for Pressure, Differential Pressure and DP based Flow /Level measurements shall be genuine, verifiable PROFIBUS PA protocol compatible instruments. The transmitters shall be connected to DDCMIS through PROFIBUS PA protocol complying to IEC 61158 directly from transmitter. This is subject to customer approval and BHEL decision shall be final.

5.0 ON OFF and INCHING type actuators (Non-intrusive type) shall be PROFIBUS-DP compatible with Open/Close command termination logic suitably built inside the actuator.

6.0 The PROFIBUS protocol design shall be further validated by BHEL and approved by NTPC during detailed engineering and any variation/ changes required based on DDCMIS system requirements and actual field installation, operational philosophy etc. shall be considered by bidder without any implications.

7.0 All transmitters shall be suitably grouped together and mounted inside (i) Local Instruments Enclosures (LIEs) in case of open areas of the plant and (ii) In Local Instrument Racks (LIRs) in case of covered areas.

8.0 Complete C&I system for SCS System is in bidder's scope of supply. Items not specifically mentioned however required for the completeness of the system shall be supplied by bidder without any commercial implication.

9.0 The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire SCS system. The requirements given are to be read in conjunction with detailed Technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.

10.0 The quantity of instruments for the system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

11.0 415V AC Power supply shall be provided by BHEL at a single point (Please refer the Electrical Specification for more detail), further distribution to various instruments/equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board, changeover circuit in his scope. Any power supply other than the above, UPS power etc., if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid.

12.0 Power supply derived for contact interrogation, interposing relay and solenoid shall generally be ungrounded 24 V D.C. only.

13.0 The make of the items shall be from sub-vendor list. However the make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict or repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

14.0 The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards.

15.0 The scope of cable shall be referred in Electrical scope split sheet in Electrical portion of the specification.

16.0 Bidder shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. All cable interconnection details for complete system shall be in Bidders' scope.

17.0 Instrument installation and accessories required for the same shall be in Bidder's scope and shall be subject to customer/BHEL's approval during detailed engineering.

18.0 Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.

19.0 Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

20.0 Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.

21.0 To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.

22.0 Redundancy of sensors shall be provided by bidder

(i) Triple redundancy for all analog and binary inputs required for protection of system/drives.

(ii) For all other control functions dual redundancy of the sensors shall be provided by the bidders.

23.0 The design of the control systems and related equipment shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved and shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips are avoided/ minimized.

24.0 All panels, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on

both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).

25.0 Bidder to perform tests of C&I items/instruments/systems as per quality plans/type test attached in the specification.

26.0 The requirements given are to be read in conjunction with detailed Technical specification enclosed.

27.0 The bidders shall specifically mention any deviation they would like to take on the C&I specification. In absence of only deviation, a “No deviation” certificate is to be furnished.

28.0 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange (SS316 material), nuts & bolts etc. shall also be included, wherever required with the field instruments.

29.0 For instruments which are not located inside covered building, suitable canopy/ protective arrangement shall be provided which shall be approved during detail engineering.

30.0 All the wetted parts of the instruments including the accessories like root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments as well as valves shall be of SS-316 material, suitable pressure class and same shall be in bidder’s scope.

31.0 All instruments should be supplied with valid calibration and test certificates provided by OEM.

32.0 At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc.

33.0 Double root valve shall be provided for all pressure tapings where the design pressure exceeds 40kg/cm2.

34.0 All the instruments PG/DPG/DPT/PT etc. as applicable shall have chemical/diaphragm seal.

35.0 Number of pairs to be selected for Screen/ Control cable

(a) F-Type: 2P/4P/8P/12P(Size : 0.5 mm2)

(b) G-Type: 2P/4P/8P/12P(Size : 0.5 mm2)

(c) Core Cable: 3CX2.5sqmm2/ 5CX2.5sqmm2/ 12CX1.5sqmm2

36.0 Drive control philosophy/signal exchange list attached elsewhere in the specification are Tentative and shall be finalized during detailed engineering.

37.0 Bidder to provide mandatory spares as per mandatory spares list. Attached elsewhere in the specification

38.0 Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract: List of Drawings/Documents and data to be furnished by bidder after award of the contract are mentioned under section" List Of Documents/Deliverables".

Note:-

1. All equipment items shall be of latest design with proven on track record.
2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.
3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.

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C&I SCOPE MATRIX FOR SCS

SCOPE MATRIX - SCS SYSTEM

S.No.	PROJECT	NTPC FGD PACKAGES - LOT 1A, 2, 3
1	**SYSTEM APPLICABLE: SELF CLEANING STRAINER (SCS)**	Y
2	**SYSTEM CONFIGURATION: UNITISED OR COMMON OR AS APPLICABLE**	COMMON
3	**CONTROL SYSTEM**	REFER NOTE-1
4	**LOCATION OF CONTROL SYSTEM**	
5	**CONTROL SYSTEM SCOPE (BIDDER /BHEL/ CUSTOMER)**	
6	**CONTROL FROM PUSH BUTTONS ON STARTER PANEL**	Y; REFER NOTE 3
7	**ANNUNCIATION ON STARTER PANEL (Y/N) -- IF Y, MIN NO. OF HARDWIRED ALARMS / INDICATIONS**	Y; REFER NOTE-4
8	**MIMIC ON STARTER PANEL (Y/N)**	NA
9	**PROTECTION CLASS FOR STARTER PANEL**	AS PER DATASHEET OF 'LOCAL CONTROL CUM STARTER PANEL' (herein also referred as 'Starter Panel' or 'Local Control Panel' or 'Switchgear Panel' interchangeably)
10	**ACTUATOR WITH INTEGRAL STARTER(Non-intrusive type)) (Y/N) - SHALL BE FOUNDATION FIELDBUS/PROFIBUS-DP PROTOCOL COMPATIBLE.**	Y
11	**DPG/ DPT PER COLTCS SYSTEM *** **TRANSMITTERs SHALL BE FOUNDATION FIELDBUS/PROFIBUS-PA PROTOCOL COMPATIBLE.**	DIFFERENTIAL PRESSURE TRANSMITTER = 2 nos. (Across each Filter) DIFFERENTIAL PRESSURE GAUGE = 1 no. (Across each Filter)
12	**SEA WATER APPLICATION**	NA

	NOTES:
1	Type of control system shall be DDCMIS (FGD-DCS) based, located in FGD - Control Room in BHEL scope. Field instrumentation and starter panels for the package are in bidder's scope of supply.
2	Self cleaning strainer shall be supplied with its Local control panel/Starter panel and its annunciation for its operation. Extent of annunciation shall be decided during detailed engg.

3	Push buttons and indication lamps for Open/Close and Start/Stop of drives/equipments shall be provided on the starter panel. Remote and local indication, indicating lamps / LED cluster for instruments/drives/equipments status and critical alarms shall be provided on the starter panel. Nos. shall be decided during detailed engineering.
4	415 V, 3 phase AC power supply shall be provided by BHEL at a single point for the starter panel. Further any electrical distribution shall be in bidder's scope. Any other voltage requirement to be arranged/derived by bidder by providing suitable control transformer. Starter panel in bidder's scope shall have provision for redundant feeder with fast automatic changeover if redundant feeder is applicable.
5	Bidder to terminate all control elements in the local control cum starter panel/Junction box for further cabling to DDCMIS.
6	Following documents shall be provided by bidder during detailed engineering for approval: a. Input/Output list, Drives list, b. Instrument datasheets and check lists/Quality plan, c. Panel external/internal GA drawing and termination details, d. Panel datasheet and QAP e. Recommended control logics / Control philosophy . f. Complete cable schedule & cable interconnection details
7	All the instruments along with necessary fittings, accessories and valve manifold etc., instrument rack and junction boxes, erection hardware shall be in bidder's scope of supply.
8	LIR/LIE shall be provided for mounting the instruments in the field.
9	Mandatory spare list shall be referred in 'List of mandatory spares' attached elsewhere in the specification and shall be supplied by bidder.
10	Open/close limit switch feedback of valves are to be connected to DCS for remote viewing and for interlock & protection.
11	The Vendor list/ sub-vendor list shall be subject to BHEL / Customer approval during contract stage.
12	The technical requirements for instruments mentioned in the specification are minimum requirements. Items not specifically mentioned and required for the completeness of the system shall be supplied by bidder.

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GENERAL TECHNICAL REQUIREMENTS (SCS SYSTEM)

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0 The quantity of instruments for auxiliary system shall be as per tender P &ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.

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LIST OF DOCUMENTS/DELIVERABLES

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT FOR NTPC FGD PACKAGES - LOT 1A, 2, 3

DOCUMENT NUMBER PE-GL-457/463/466/467/468-145-I100 SHEET 1 of 1

Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-XXX-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-XXX-145-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V0-XXX-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V0-XXX-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V0-XXX-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V0-XXX-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V0-XXX-145-I907	FIELD JB/LIE/LIR, DRIVES TERMINATIONS	A
8	PE-V0-XXX-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V0-XXX-145-I909	QUALITY PLANS (INSTRUMENTS,LCP etc.)	A
10	PE-V0-XXX-145-I910	INSTRUMENT HOOK UP DRAWING	A
11	PE-V0-XXX-145-I911	THERMOWELL SIZING CALCULATION	A
12	PE-V0-XXX-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V0-XXX-145-I914	ANNUNCIATION & SOE LIST	A

NOTES:

1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.
2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.
3. 'XXX' REFERS TO SPECIFIC PROJECT CODE AS APPLICABLE.

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SPECIFICATION FOR MEASURING INSTRUMENTS (PRIMARY & SECONDARY) AND CONTROL PANEL

CLAUSE NO.	TECHNICAL REQUIREMENTS	Annexure-IIIC
1.00.00	**MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)**	
1.01.00	Measuring instruments/equipment and subsystems offered by the Bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further, all instruments shall be of proven reliability, accuracy, and repeatability requiring a minimum of maintenance and shall comply with the acceptable international standards and shall be subject to Employer's approval.	
1.02.00	Every panel-mounted instrument requiring power supply shall be provided with easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.	
1.03.00	All transmitters, sensors, switches and gauges for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment in the system under the scope of specification shall be provided on as required basis with in quoted lump sum price. The Contractor shall furnish all Instrumentation / Control equipment & accessories under this specification as per technical specification, ranges, makes & model as approved by the Employer during detailed engineering.	
1.04.00	The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg./sq.cm.	
1.07.00	The instruments, for which technical specification is not attached, shall be supplied as per the standard and proven practice of the contractor. The same shall be established by the contractor during detailed engineering by providing detailed explanation/concepts, if required by the employer, of such implementation along with standard documentation.	

16.00.00 **FIELD INSTRUMENTS BASED ON FIELDBUS**

The following instruments shall be connected to DDCMIS through fieldbus i.e. FOUNDATION Fieldbus/PROFIBUS PA protocol complying to IEC 61158 directly from transmitter.

16.01.00 **Electronic Transmitter for Pressure, Differential Pressure and DP based Flow / Level measurements.**

S No.	Features	Essential/Minimum Requirements
1.	Type of Transmitter	FOUNDATION Fieldbus/PROFIBUS PA based output

CLAUSE NO.	TECHNICAL REQUIREMENTS		
	2	Accuracy	± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc. +0.065% of calibrated range (minimum) for calibrated range greater than 250 kg/cm2. ± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc.
	3.	Stability	0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer. 0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer. 0.15% of calibrated range for 5 years for DPT with static pressure greater than 250 kg/cm2.
	4	Turn down	50:1 for greater than or equal to span of 400mmwcl. 20:1 for span below 400mmwcl. 10:1 for span greater than 250 kg/cm2
	(Above mentioned (2,3,4) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).		
	5	Housing	Weather proof as per IP-67, metallic housing with durable corrosion resistant coating
	6.	Electrical connection	½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible
	7.	Process connection	½" NPT (F)
	8.	Operating Ambient temperature	85 deg C without display. 70 deg C with display.
		Overpressure	150% of max operating pressure
	9	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. -2 valve manifold for absolute & gauge pressure transmitters, -3-valve for DP and 5 valve manifold for level/flow applications. -The valve manifold shall be non-integral type. -For hazardous area, enclosure as described in NEC article 5.

10.	Mounting	2 inch pipe mounting with Enclosure/Rack/Canopy.
11.	Diagnostics & display	Self-Indicating feature and digital display on transmitter

Notes

- For primary air/ secondary air/flue gas/ furnace pressure applications, DP type transmitters shall be provided for pressure measurement below 2000 mmwc.
- LVDT type is not acceptable.
- Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

CLAUSE NO.	TECHNICAL REQUIREMENTS

4.00.00 **SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.**

Sl. No	FEATURES	ESSENTIAL/MINIMUM REQUIREMENTS		
		Pr. Gauge/ DP Gauge/ Draught gauges	Temperature Gauge	Level Gauge
1	Sensing Element	Bourdon for high pressure, Diaphragm/ Bellow for low pr.	Inert gas actuated/ Liquid filled other than mercury	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Material of sensing element	SS 316	SS 316	
3	Material of movement	SS 304	SS 304	
4	Body material	Die-cast aluminium	Die-cast aluminium	Forged carbon steel/304 SS
5	Dial size	150mm	150 mm	Tubular covering entire range
6	End connection	1/2 inch NPT (M)	1/2 inch or 3/4 inch NPT (M).	Process connection as per ASME PTC and drain/vent 15 NB

7	Accuracy	±1% of span	± 1% of span	± 2%
8	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
9	Range selection	Shall cover 125% of max. operating press	Shall cover 125% of max. operating temp	Shall cover max. Operating level.
10	Over range	125% of FSD	125% of FSD	-
11	Housing	Weather and dust proof as per IP-55	Weather and dust proof as per IP-55	CS/304 SS leak proof
12	Zero/span adjustment	Provided	Provided	–
13	Identification	Engraved with service legend or laminated phenolic name plate		
14	Accessories	Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement.
Notes:-				

*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

10.00.00 **FIELD MOUNTED LOCAL JUNCTION BOXES**

(i)	No. of ways	12/24/36/48/64/72/96/128 with 20% spares terminals.
(ii)	Material and Thickness	4mm thick Fiberglass Reinforced Polyester (FRP).
(iii)	Type	Screwed at all four corners for door. Door gasket shall be of synthetic rubber.
(iv)	Mounting clamps and accessories	Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply.
(v)	Type of terminal blocks	Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm^2. A M6 earthing stud shall be provided.
(vi)	Protection Class	IP: 55 minimum for indoor & IP-65 minimum for outdoor applications.
(vii)	Grounding	To be provided.
(viii)	Color	RAL 7035

CLAUSE NO.	TECHNICAL REQUIREMENTS
10.00.00	**CONTROL CABINETS / PANELS / DESKS**
10.01.00	The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.
10.01.01	The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.

10.01.02	The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.
10.01.03	Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.
10.01.04	Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades: (a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalised during detailed engineering. (b.) Interior:- Same as above.
10.01.05	Paint films which show sags, checks or other imperfections shall not be acceptable.
10.01.05	As an alternative, single coat of anodic dipcoat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.
10.01.06	Refer Subsection Basic Design Criteria, Part-B, Section-VI for grounding requirements.
10.02.00	The mimic shall be configured on the OWS/CRTs and it shall be possible to control, monitor and operate the plant from the same.
10.03.00	The technical specification covering panel fabrication details, wiring and termination details etc. shall be as described under Sub-Section INST CABLE of this specification.

CLAUSE NO.	TECHNICAL REQUIREMENTS

5.00.00 PROCESS ACTUATED SWITCHES

FEATURES	ESSENTIAL / MINIMUM REQUIREMENTS		
	Pressure/ Draft Switches/ DP Switches	Temperature switches	Level switches
Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (5 m minimum, to suit application)	Capacitance types, float type, conductivity type, RF type, Ultrasonic type as per suitability to the application. .
Material	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
Over range/ proof pressure	150% of maximum operating pr.	-	150% of maximum operating pr.
Repeatability	+/- 0.5% of full range		
No. of contacts	2 No.+2NC. SPDT snap action dry contact		
Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS)		
Elect. Connection	Plug in socket.		
Set point adjustment	Provided over full range.		
Dead band adjustment	Adjustable/ fixed as per requirement of application.		
Enclosure	Weather and dust proof as per IP-55, metallic housing.		
Accessories	Siphon, snubber, chemical seal, pulsation dampeners as required by process	Thermo well of 316 SS and packing glands	All mounting accessories
Mounting	Suitable for enclosure/ rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-

Power Supply (wherever required)	As per Contractor's Standard practice.

Notes :-

1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications.

3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice.

6.00.00 SOLENOID VALVES

Solenoid valves shall fulfill the following requirements: -

a) Type 2/3/4 way SS 316/ forged brass (depending on the application subject to Employer's approval during detailed engg.)

b) Power supply 24V DC.

c) Plug in connector connection.

d) Insulation : Class "H"

7.00.00 Limit switches

e) Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of Fire alarm Control System subject to a minimum of 60V, 6VA rating. Protection class shall be IP-55.

SUB-SECTION – ID

DATASHEET-A

	DATA SHEET - A							SPECIFICATION NO.: PE-TS-RC5-165-N004
	SELF CLEANING STRAINER (SCS)							REV. NO.: 00. DATE : 07/07/2021
								SECTION : I. SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**TYPE - 1**	**TYPE-2**	**TYPE - 3**	**TYPE - 4**	**TYPE - 5**	**TYPE - 6**
1.0	**GENERAL**							
1.1	No. of Strainers/ Filters required for station	Nos.	Total =6 sets for all units/projects. [2 Sets per unit i.e.(1 Working + 1 Standby)]	Total =2 sets for all units/projects. [2 Sets per unit i.e.(1 Working + 1 Standby)]	Total =4 sets for all units/projects. [2 Sets per unit i.e.(1 Working + 1 Standby)]	Total 2 Sets - i.e.(1 Working + 1 Standby)	Total =8 sets for all units/projects. [2 Sets per unit i.e.(1 Working + 1 Standby)]	Total =4 sets for all units/projects. [2 Sets per unit i.e.(1 Working + 1 Standby)]
1.2	Liquid Handled		CW Blowdwon water	CW Blowdwon water	CW Blowdwon water	CW Blowdwon water	CW Blowdwon water	CW Blowdwon water
1.3	Size of SCS Shell	NB	300	150	150	300	200	250
1.4	Length of SCS Shell	mm	As per Bidder standard	As per Bidder standard	As per Bidder standard	As per Bidder standard	As per Bidder standard	As per Bidder standard
1.5	Connecting pipe size (OD x Thk)	mm x mm	323.9 X 6.0	166.5 X 5.4	166.5 X 5.4	323.9 x 6.0	219.1 X 6.0	273 X 6.0
1.6	Scope of Counter Flange of SCS Shell		In bidder's scope	In bidder's scope	In bidder's scope	In bidder's scope	In bidder's scope	In bidder's scope
1.7	BOQ for Debris Discharge Piping (For CW Blow down water).		1. Dia of pipe: To be decided by bidder. 2. Length of pipe: 50 m pipe length. 3. No. of bends: 5 Nos.	1. Dia of pipe: To be decided by bidder. 2. Length of pipe: 50 m pipe length. 3. No. of bends: 5 Nos.	1. Dia of pipe: To be decided by bidder. 2. Length of pipe: 50 m pipe length. 3. No. of bends: 5 Nos.	1. Dia of pipe: To be decided by bidder. 2. Length of pipe: 50 m pipe length. 3. No. of bends: 5 Nos.	1. Dia of pipe: To be decided by bidder. 2. Length of pipe: 50 m pipe length. 3. No. of bends: 5 Nos.	1. Dia of pipe: To be decided by bidder. 2. Length of pipe: 50 m pipe length. 3. No. of bends: 5 Nos.
1.8	Filter type/ duty		On line / continuous	On line / continuous	On line / continuous	On line / continuous	On line / continuous	On line / continuous
1.9	Location		ACW Pump Discharge Header (Outdoor)	ACW Pump Discharge Header (Outdoor)	ACW Pump Discharge Header (Outdoor)	ACW Pump Discharge Header (Outdoor)	ACW Pump Discharge Header (Outdoor)	ACW Pump Discharge Header (Outdoor)
2	**DESIGN DATA**							
2.1	Operating pressure at SCS Inlet Flange	kg/cm2 (g)	3.5 - 5.5	3.5 - 5.5	3.5 - 5.5	3.5 - 5.5	3.5 - 6.7	3.5 - 6.7
2.2	Design pressure for SCS Shell	kg/cm2 (g)	7.5	7.5	7.5	7.5	7.5	7.5
2.3	Design Mechanical temperature	Deg. C	60	60	60	60	60	60
2.4	Flow rate through filter							
	a) Normal	Cub m/Hr	525	150	150	650	250	375
	b) Maximum	Cub m/Hr	682.5	195	195	845	325	487.5
2.5	Design differential pressure for filter section/ screen	kg/cm2 (g)	1.5 (Min.)	1.5 (Min.)	1.5 (Min.)	1.5 (Min.)	1.5 (Min.)	1.5 (Min.)
2.6	Type of suspended matter likely to enter the filter		Typical debris encountered in closed circuit ACW system with Cooling Tower	Typical debris encountered in closed circuit ACW system	Typical debris encountered in closed circuit ACW system	Typical debris encountered in closed circuit ACW system	Typical debris encountered in closed circuit ACW system	Typical debris encountered in closed circuit ACW system
2.7	Differential pressure measuring system set pressure							
	· For initiating flushing/ backwashing	mbar	110	110	110	110	110	110
	· For alarm/ annunciation	mbar	160	160	160	160	160	160
2.8	Filter section/ screen perforation size	mm	2 mm (max)	1 mm (max)	2 mm (max)	2 mm (max)	2 mm (max)	2 mm (max)
2.9	Free flow area in the screen basket		Atleast 120 % of pipe inlet area	Atleast 120 % of pipe inlet area	Atleast 120 % of pipe inlet area	Atleast 120 % of pipe inlet area	Atleast 120 % of pipe inlet area	Atleast 120 % of pipe inlet area
2.1	Debris discharge flow during flushing period	Cub m/ Hr.	Not to exceed 3% of total flow rate	Not to exceed 3% of total flow rate	Not to exceed 3% of total flow rate	Not to exceed 3% of total flow rate	Not to exceed 3% of total flow rate	Not to exceed 3% of total flow rate
3	**GUARANTEED PERFORMANCE REQUIREMENT**							
3.1	Pressure drop across the filter (i.e. between inlet and outlet connection) at normal flow							
	a) Clean condition	MWC	1 MWC	2.5 MWC	1 MWC	1 MWC	1 MWC	1 MWC
	b) Partially (50%) chocked condition	MWC	1.6 MWC	4.0 MWC	1.6 MWC	1.6 MWC	1.6 MWC	1.6 MWC
4	**MATERIALS OF CONSTRUCTION**							
4.1	Filter body/ housing including Body Flange		IS:210 Gr. FG260 or ASTM-A-515 Gr. 75/IS:2062 and internally painted with epoxy (with minimum housing thickness same as connecting pipe thickness)	Carbon steel IS 2062 Gr.B and internally painted with epoxy (with minimum housing thickness same as connecting pipe thickness)	Carbon steel IS 2062 Gr.B and internally painted with epoxy (with minimum housing thickness same as connecting pipe thickness)	IS:210 Gr. FG260 or ASTM-A-515 Gr. 75/IS:2062 and internally painted with epoxy (with minimum housing thickness same as connecting pipe thickness)	IS:210 Gr. FG260 or ASTM-A-515 Gr. 75/IS:2062 and internally painted with epoxy (with minimum housing thickness same as connecting pipe thickness)	IS:210 Gr. FG260 or ASTM-A-515 Gr. 75/IS:2062 and internally painted with epoxy (with minimum housing thickness same as connecting pipe thickness)
4.2	Connecting pipe (Inlet/ Outlet)		CS to IS 2062 Gr. E-250B, rolled & butt welded, conforming to IS 3589	Carbon Steel ERW as per IS1239 (Heavy Grade)	Carbon Steel ERW as per IS1239 (Heavy Grade)	CS to IS 2062 Gr. E-250B, rolled & butt welded, conforming to IS 3589	CS to IS 2062 Gr. E-250B, rolled & butt welded, conforming to IS 3589	CS to IS 2062 Gr. E-250B, rolled & butt welded, conforming to IS 3589
4.3	Filter screen/ section		SS 316	SS 316	SS 316	SS 316	SS 316	SS 316
4.4	Shaft		SS 316	SS 316	SS 316	SS 316	SS 316	SS 316
4.5	Supporting cage		SS 316	SS 316	SS 316	SS 316	SS 316	SS 316
4.6	Differential measuring system		SS 316	SS 316	SS 316	SS 316	SS 316	SS 316
4.7	Flushing/ backwashing unit		SS 316	SS 316	SS 316	SS 316	SS 316	SS 316
4.8	Backwash rotor shoes		Neoprene	Neoprene	Neoprene	Neoprene	Neoprene	Neoprene
4.9	Any other internal hardware /pipes etc.		SS 316	SS 316	SS 316	SS 316	SS 316	SS 316
4.1	Flushing Pump (If applicable)							
	a) Casing		CI to IS 210 FG 260	CI to IS 210 FG 260	CI to IS 210 FG 260	CI to IS 210 FG 260	CI to IS 210 FG 260	CI to IS 210 FG 260
	b) Impeller		SS-316	SS-316	SS-316	SS-316	SS-316	SS-316
	c) Shaft		SS-316	SS-316	SS-316	SS-316	SS-316	SS-316

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	SELF CLEANING STRAINER (SCS)							REV. NO.: 00. DATE : 07/07/2021
								SECTION : I. SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**TYPE - 1**	**TYPE-2**	**TYPE - 3**	**TYPE - 4**	**TYPE - 5**	**TYPE - 6**
4.11	Valves							
4.11.1	Check Valves (65 NB & Above)		For sizes 65 NB and above-Swing check type or dual plate type. End connection shall be flanged type.	For sizes 65 NB and above-Swing check type or dual plate type. End connection shall be flanged type.	For sizes 65 NB and above-Swing check type or dual plate type. End connection shall be flanged type.	For sizes 65 NB and above-Swing check type or dual plate type. End connection shall be flanged type.	For sizes 65 NB and above-Swing check type or dual plate type. End connection shall be flanged type.	For sizes 65 NB and above-Swing check type or dual plate type. End connection shall be flanged type.
	a) Body & Bonnet		Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.
	b) Disc for Check Valve		SS-316	Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.	SS-316	SS-316	SS-316
	c) Stem		ASTM A-182 Gr. F6a	ASTM A-182 Gr. F6 or equivalent	ASTM A-182 Gr. F6 or equivalent	ASTM A-182 Gr. F6a	ASTM A-182 Gr. F6a	ASTM A-182 Gr. F6a
4.11.2	Check Valves (50 NB & Below)		For size 50 NB and below-Piston type End connection shall be socket welded type.	For size 50 NB and below-Piston type End connection shall be socket welded type.	For size 50 NB and below-Piston type End connection shall be socket welded type.	For size 50 NB and below-Piston type End connection shall be socket welded type.	For size 50 NB and below-Piston type End connection shall be socket welded type.	For size 50 NB and below-Piston type End connection shall be socket welded type.
	a) Body & Bonnet		Carbon steel as per ASTM A-105	Carbon steel as per ASTM A-105	Carbon steel as per ASTM A-105	Carbon steel as per ASTM A-105	Carbon steel as per ASTM A-105	Carbon steel as per ASTM A-105
	b) Disc for Check Valve		SS-316	SS-316	SS-316	SS-316	SS-316	SS-316
	c) Stem		13% Cr Steel as per ASTM A-182 Gr. F6a.	13% Cr Steel as per ASTM A-182 Gr. F6a.	13% Cr Steel as per ASTM A-182 Gr. F6a.	13% Cr Steel as per ASTM A-182 Gr. F6a.	13% Cr Steel as per ASTM A-182 Gr. F6a.	13% Cr Steel as per ASTM A-182 Gr. F6a.
4.11.3	Gate/ Globe Valves 50 Nb & Below		End connection shall be socket welded type.	End connection shall be socket welded type.	End connection shall be socket welded type.	End connection shall be socket welded type.	End connection shall be socket welded type.	End connection shall be socket welded type.
	Body & Bonnet		Carbon steel as per ASTM A-105	Carbon steel as per ASTM A-105	Carbon steel as per ASTM A-105	Carbon steel as per ASTM A-105	Carbon steel as per ASTM A-105	Carbon steel as per ASTM A-105
4.11.4	Gate/Globe Valves (65NB & above)		End connection shall be flanged type.	End connection shall be flanged type.	End connection shall be flanged type.	End connection shall be flanged type.	End connection shall be flanged type.	End connection shall be flanged type.
	a) Body & Bonnet		Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.
	b) Disc		SS-316	Carbon Steel as per ASTM-A216-Gr. WCB.	Carbon Steel as per ASTM-A216-Gr. WCB.	SS-316	SS-316	SS-316
	c) Stem		ASTM A-182 Gr. F6a	ASTM A-182 Gr. F6 or equivalent	ASTM A-182 Gr. F6 or equivalent	ASTM A-182 Gr. F6a	ASTM A-182 Gr. F6a	ASTM A-182 Gr. F6a
4.11.5	BFV Valves (65NB & above)							
	a) Body & Disc		2 % Ni CI to IS-210 GR FG-260	2 % Ni CI to IS-210 GR FG-260	2 % Ni CI to IS-210 GR FG-260	2 % Ni CI to IS-210 GR FG-260	2 % Ni CI to IS-210 GR FG-260	2 % Ni CI to IS-210 GR FG-260
	b) Sealing, Retaining segment & internals		SS-304	SS-304	SS-304	SS-304	SS-304	SS-304
	c) Bearing		Self lubricating type	Self lubricating type	Self lubricating type	Self lubricating type	Self lubricating type	Self lubricating type
	d) Companinon Flange		-	-	-		-	-
4.11.6	Ball valves							
	i) Body		SA 351 CF8M	SA 351 CF8M	SA 351 CF8M	SA 351 CF8M	SA 351 CF8M	SA 351 CF8M
	ii) Ball		SA 351 CF8M	SA 351 CF8M	SA 351 CF8M	SA 351 CF8M	SA 351 CF8M	SA 351 CF8M
	iii) Stem		SS 318	SS 318	SS 318	SS 318	SS 318	SS 318
4.12	Debris discharge/ Interconnecting Piping material							
			a) Up to 150 NB - Carbon steel ERW, IS:1239 (Heavy Grade). b) 200 NB and above - CS to IS 2062 Gr. E-250B, rolled & butt welded, conforming to IS 3589	a) Up to 150 NB - Carbon steel ERW, IS:1239 (Heavy Grade). b) 200 NB and above - CS to IS 2062 Gr. B, rolled & butt welded, conforming to IS 3589	a) Up to 150 NB - Carbon steel ERW, IS:1239 (Heavy Grade). b) 200 NB and above - CS to IS 2062 Gr. B, rolled & butt welded, conforming to IS 3589	a) Up to 150 NB - Carbon steel ERW, IS:1239 (Heavy Grade). b) 200 NB and above - CS to IS 2062 Gr. E-250B, rolled & butt welded, conforming to IS 3589	a) Up to 150 NB - Carbon steel ERW, IS:1239 (Heavy Grade). b) 200 NB and above - CS to IS 2062 Gr. E-250B, rolled & butt welded, conforming to IS 3589	a) Up to 150 NB - Carbon steel ERW, IS:1239 (Heavy Grade). b) 200 NB and above - CS to IS 2062 Gr. E-250B, rolled & butt welded, conforming to IS 3589
4.13	Inspection hole		Required	Required	Required	Required	Required	Required
5	**COUNTER FLANGES FOR SCS SHELL**		In Bidder's Scope	In Bidder's Scope	In Bidder's Scope	In Bidder's Scope	In Bidder's Scope	In Bidder's Scope
5.1	MATERIAL							
	a) Flanges		IS 2062, Gr. E-250B, epoxy painted	IS 2062, Gr. B, epoxy painted	IS 2062, Gr. B, epoxy painted	IS 2062, Gr. E-250B, epoxy painted	IS 2062, Gr. E-250B, epoxy painted	IS 2062, Gr. E-250B, epoxy painted
	b) Fasteners		A 193 & A 194	A 193 & A 194	A 193 & A 194	A 193 & A 194	A 193 & A 194	A 193 & A 194
	c) Gaskets		Min 4 mm thick rubber	Min 4 mm thick rubber	Min 4 mm thick rubber	Min 4 mm thick rubber	Min 4 mm thick rubber	Min 4 mm thick rubber
5.2	Drilling Standard		ANSI B 16.5 / AWWA C 207 / BS EN 1092 or equivalent	ANSI B 16.5 / AWWA C 207 / BS EN 1092 or equivalent	ANSI B 16.5 / AWWA C 207 / BS EN 1092 or equivalent	ANSI B 16.5 / AWWA C 207 / BS EN 1092 or equivalent	ANSI B 16.5 / AWWA C 207 / BS EN 1092 or equivalent	ANSI B 16.5 / AWWA C 207 / BS EN 1092 or equivalent
6	**OTHER COUNTER FLANGES**		In Bidder's Scope	In Bidder's Scope	In Bidder's Scope	In Bidder's Scope	In Bidder's Scope	In Bidder's Scope
6.1	MATERIAL							
	a) Flanges		IS 2062, Gr. E-250B, epoxy painted	IS 2062, Gr. B, epoxy painted	IS 2062, Gr. B, epoxy painted	IS 2062, Gr. E-250B, epoxy painted	IS 2062, Gr. E-250B, epoxy painted	IS 2062, Gr. E-250B, epoxy painted
	b) Fasteners		A 193 & A 194	A 193 & A 194	A 193 & A 194	A 193 & A 194	A 193 & A 194	A 193 & A 194
	c) Gaskets		Min 4 mm thick rubber	Min 4 mm thick rubber	Min 4 mm thick rubber	Min 4 mm thick rubber	Min 4 mm thick rubber	Min 4 mm thick rubber
7	**Material of Other components not specified above**		Suitable for intended duty & water quality	Suitable for intended duty & water quality	Suitable for intended duty & water quality	Suitable for intended duty & water quality	Suitable for intended duty & water quality	Suitable for intended duty & water quality

	DATA SHEET - A							SPECIFICATION NO.: PE-TS-RC5-165-N004
	SELF CLEANING STRAINER (SCS)							REV. NO.: 00. DATE : 07/07/2021
								SECTION : I. SUB-SECTION : ID
SL NO	**DESCRIPTION**	**UNITS**	**TYPE - 1**	**TYPE-2**	**TYPE - 3**	**TYPE - 4**	**TYPE - 5**	**TYPE - 6**
8	**PAINTING**							
8.1	External Surface							
	a) Surface preparation		All surface other than stainless steels shall be painted. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by shotblasting (SA 2.5) etc shall be subjected to BHEL/Customer approval. For all the steel surfaces, a coat of chlorinated rubber based zinc phosphate primer of minimum thickness DFT of 50 microns followed up with undercoat of chlorinated rubber paint of minimum DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with minimum DFT of 50 microns and topcoat consisting of two coats of chlorinated rubber paint of approved shade and color with glossy finish and DFT of 100 microns shall be provided. Total DFT of paint system shall not be less than 200 microns.	The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot-blasting etc. For all the steel surfaces exposed to (outdoor installation) atmosphere, a coat of chlorinated rubber based zinc phosphate primer of minimum thickness DFT of 50 microns followed up with undercoat of chlorinated rubber paint of minimum DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with minimum DFT of 50 microns and topcoat consisting of two coats of chlorinated rubber paint of approved shade and color with glossy finish and DFT of 100 microns shall be provided. Total DFT of paint system shall not be less than 200 microns.	The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shot-blasting etc. For all the steel surfaces exposed to (outdoor installation) atmosphere, a coat of chlorinated rubber based zinc phosphate primer of minimum thickness DFT of 50 microns followed up with undercoat of chlorinated rubber paint of minimum DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with minimum DFT of 50 microns and topcoat consisting of two coats of chlorinated rubber paint of approved shade and color with glossy finish and DFT of 100 microns shall be provided. Total DFT of paint system shall not be less than 200 microns.	All surface other than stainless steels shall be painted. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by shotblasting (SA 2.5) etc shall be subjected to BHEL/Customer approval. 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For all the steel surfaces, a coat of chlorinated rubber based zinc phosphate primer of minimum thickness DFT of 50 microns followed up with undercoat of chlorinated rubber paint of minimum DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with minimum DFT of 50 microns and topcoat consisting of two coats of chlorinated rubber paint of approved shade and color with glossy finish and DFT of 100 microns shall be provided. Total DFT of paint system shall not be less than 200 microns.	All surface other than stainless steels shall be painted. The steel surface to be applied with painting shall be thoroughly cleaned before applying painting by shotblasting (SA 2.5) etc shall be subjected to BHEL/Customer approval. For all the steel surfaces, a coat of chlorinated rubber based zinc phosphate primer of minimum thickness DFT of 50 microns followed up with undercoat of chlorinated rubber paint of minimum DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with minimum DFT of 50 microns and topcoat consisting of two coats of chlorinated rubber paint of approved shade and color with glossy finish and DFT of 100 microns shall be provided. Total DFT of paint system shall not be less than 200 microns.
	b) Primer							
	c) Intermediate							
	c) Final paint							
8.2	Internal Surface							
	a) Surface preparation		SA 2.5 of Swedish Specification SIS 05.5900.197	SA 2.5 of Swedish Specification SIS 05.5900.197	SA 2.5 of Swedish Specification SIS 05.5900.197	SA 2.5 of Swedish Specification SIS 05.5900.197	SA 2.5 of Swedish Specification SIS 05.5900.197	SA 2.5 of Swedish Specification SIS 05.5900.197
	b) Primer		One coat of epoxy resin based primer	One coat of epoxy resin based primer	One coat of epoxy resin based primer	One coat of epoxy resin based primer	One coat of epoxy resin based primer	One coat of epoxy resin based primer
	c) Final paint		Applicable no. Of coats of coal tar epoxy paint to achieve total DFT of 200 to 250 microns	Applicable no. Of coats of coal tar epoxy paint to achieve total DFT of 200 to 250 microns	Applicable no. Of coats of coal tar epoxy paint to achieve total DFT of 200 to 250 microns	Applicable no. Of coats of coal tar epoxy paint to achieve total DFT of 200 to 250 microns	Applicable no. Of coats of coal tar epoxy paint to achieve total DFT of 200 to 250 microns	Applicable no. Of coats of coal tar epoxy paint to achieve total DFT of 200 to 250 microns
9	**SHOP TEST**							
9.1	Hydrostatic test							
	a) Test Pressure	bar (g)	1.5 times design pressure	1.5 times design pressure	1.5 times design pressure	1.5 times design pressure	1.5 times design pressure	1.5 times design pressure
	b) Test duration	min.	30	30	30	30	30	30
9.2	Leakage test							
	a) Test Pressure	bar (g)	Design Pressure	Design Pressure	Design Pressure	Design Pressure	Design Pressure	Design Pressure
	b) Test duration	min.	30	30	30	30	30	30
10	**Adequate provision for future installation of cathodic protection required**		YES	YES	YES	YES	YES	YES
11	**Whether automatic flushing/ back- washing operation effected by the following :**							
	i. Differential pressure		YES	YES	YES	YES	YES	YES
	ii. Adjustable timer		YES	YES	YES	YES	YES	YES
	iii. Push button		YES	YES	YES	YES	YES	YES
12	**Whether provision for manual flushing / backwashing operation is made in the event of control system failure.**		YES (if required)	YES (if required)	YES (if required)	YES (if required)	YES (if required)	YES (if required)
13	**Whether built in flushing arrangement complete with flushing pump, valves, and associated piping, is provided.**		YES (if required)	YES (if required)	YES (if required)	YES (if required)	YES (if required)	YES (if required)
14	**MANDATORY SPARES**		As per Annexure-III (After data sheet-A)	As per Annexure-III (After data sheet-A)	As per Annexure-III (After data sheet-A)	As per Annexure-III (After data sheet-A)	As per Annexure-III (After data sheet-A)	As per Annexure-III (After data sheet-A)

Notes Regarding Mandatory spares:

1. Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment.

2.Any fraction of a item shall mean the next higher.

3. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case, the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number.

4. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range, etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.

5. In case, spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.

MANDATORY SPARES - SCS, RC-5

ANNEXURE-III

	1	2	3	4	5	6	7	8	9
SL.NO.	**DESCRIPTION OF EQUIPMENT / ITEM Spares to be supplied under this specification.**	**DESCRIPTION OF UNIT OF MEASUREMENT**	**UOM**	**TYPE-1**	**TYPE-2**	**TYPE-3**	**TYPE-4**	**TYPE-5**	**TYPE-6**
1	**MEASURING INSTRUMENTS:**								
	Transmitters of all types and model no. (for measurement of pressure, differential pressure, flow, level, temp, etc.). This shall include magnetic/ electromagnetic flow meter, mass flow meter also.	10% or 1 no. of each type and model, whichever is more.	LOT	1		1	1	1	1
	Local Gauges for Pressure, Differential pressure, flow, level, temp	5% or 1 no. of each type, model and range, whichever is more.	LOT	1		1	1	1	1
2	**PROCESS CONNECTION PIPING (For Impulse Piping /Tubing and Air Supply Piping as Applicable):**								
	1Valves of all types and models	10% or 1 no. of each type, class, size and model whichever is more.	LOT	1		1	1	1	1
	2 way, 3way, 5way valve manifolds	10% or 1 no. of each type, class, size and model whichever is more.	LOT	1		1	1	1	1
	Fittings	10% or 1 packet of each type, class, size and model whichever is more.	LOT	1		1	1	1	1
	Purge meters	5% of each model or 1 no. whichever is more.	LOT	1		1	1	1	1
	Filter regulators	20% of each model or 2 nos. whichever is more.	LOT	1		1	1	1	1
3	**ELECTRICAL ACTUATORS:**								
	Actuators	1 no of each type and rating	LOT	1		1	1	1	1
	Electronic PCB of all types	10% of each type & model	LOT	1		1	1	1	1
	Absolute Encoder (replaceable part)	5% of each type & model	LOT	1		1	1	1	1
	Electronic Torque sensor	5% of each type & model	LOT	1		1	1	1	1

NOTES:

1. BHEL reserves the right to order multiple lots of mandatory spares based on actual project requirement.
2. Wherever set is mentioned, one set of the spares of that item shall be for complete replacement of that particular item for one equipment.
3. Any fraction of a item shall mean the next higher.
4. Wherever quantity has been specified as percentage (%), the quantity of mandatory spares to be provided by contractor shall be the specified percentage (%) of the total population of the plant. In case, the quantity so calculated happens to be fraction, the same shall be rounded off to next higher whole number.
5. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range, etc., these shall cover all the items supplied and installed and the breakup for these shall be furnished in the bid.
6. In case, spares indicated in the list are not applicable to the particular design offered by the bidder, the bidders should offer spares applicable to offered design with quantities generally in line with the approach followed in the above list.

Water analysis for Type - 1

ANNEXURE- VI

CLARIFIED WATER ANALYSIS

Sl. No.	Constituent	as	mg/ litre St-I	mg/Litre St-II
A)	**COOLING WATER ANALYSIS /CW BLOW DOWN WATER ANALYSIS**			
1.	Calcium	$CaCO_3$	237	316
2.	Magnesium	$CaCO_3$	219	292
3.	Sodium	$CaCO_3$	195	260
4.	Potassium	$CaCO_3$	18	24
5.	Total Cations	$CaCO_3$	669	892
6.	M-Alkalnaity	$CaCO_3$	120	120
7.	P-Alkalinity	$CaCO_3$	0	0
8.	Nitrate $CaCO_3$	$CaCO_3$	6.6	8.8
9.	Chloride	$CaCO_3$	189	252
10.	Sulphate	$CaCO_3$	120	160
11.	Total Anions	$CaCO_3$	669	892
12.	Silica	SiO_2	45	60
13.	Iron	Fe	0.36	0.48
14.	pH Value	-	6.5-6.9	6.5-6.9
15.	Turbidity	NTU	4.5	6
16.	Total Dissolved solids	$CaCO_3$	735	980
17.	Organic matter (Oxygen absorbed from Acid Permanganate In 4 Hrs.)	mg/l	0.1	0.1

Note : The C.W system is expected to operate at about 3 Cycles of Concentration for St- I and 4 cycles of concentration for St-II.

Water analysis for Type - 1

CLAUSE NO.	PROJECT INFORMATION

Table-3

S.No	Constituent	As	mg/l (except pH & turbidity)
1.	Calcium	$CaCO_3$	131
2.	Magnesium	$CaCO_3$	52
3.	Sodium + Potassium	$CaCO_3$	65
4.	Total Cations	$CaCO_3$	248
5.	Chloride	$CaCO_3$	20
6.	Sulphate	$CaCO_3$	93
7.	Nitrate	$CaCO_3$	10
8.	Alkalinity	$CaCO_3$	125
9.	Total Anions	$CaCO_3$	248
10.	Iron(total)	Fe	0.3
11.	Total Silica	SiO_2	22
12.	pH value	---	7.0-8.2
13.	Turbidity	NTU	10

Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dozing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.

Table-4

ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER

Sl.No.	Characteristics	Value
1.	Silica (Max.)	0.02 ppm as Sio2
2.	Iron as Fe	Nil
3.	Total hardness	Nil
4.	pH value	6.8 -7.2
5.	Conductivity	Not more than 0.1 micro mhos/cm excluding the effects of free CO2

Water analysis for Type - 2

TABLE-II

TREATED WATER/ FGD PROCESS WATER QUALITY

Sr. Number	Item	Unit	Value
1.	**TDS of permeate from Desalination RO System**	ppm	<500
2.	Total Suspended solids	ppm	Nil
3.	Iron as Fe	ppm as Fe	<0.1
4.	Reactive Silica as SiO2	ppm as SiO2	<1.0
5.	Chloride as Cl	ppm as Cl	<200
6.	Sodium	ppm as Na	<150
7.	pH at 25 deg C	---	6.0-7.0

Table-4

DESIGN CLARIFIED WATER ANALYSIS

S.No	Constituent	As	mg/l (except pH & turbidity)
1.	Calcium	$CaCO_3$	38
2.	Magnesium	$CaCO_3$	22
3.	Chloride	$CaCO_3$	20
4.	Sulphate	$CaCO_3$	17
5.	Alkalinity	$CaCO_3$	54
6.	Iron(total)	Fe	0.1
7.	Total Silica	SiO_2	07
8.	pH value	---	7.5
9.	Turbidity	NTU	02

Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dozing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.

Table-5

ANALYSIS OF DM WATER

S.N.	Characteristics	Value
1.	Silica (Max.)	0.02 ppm as SiO2
2.	Iron (Fe)	Nil
3.	Total hardness	Nil
4.	pH value	6.8 to 7.2
5.	Conductivity	Not more than 0.1 µs/cm

Water analysis for Type - 3

TABLE-II

TREATED WATER/ FGD PROCESS WATER QUALITY

Sr. Number	Item	Unit	Value
1.	**TDS of permeate from Desalination RO System**	ppm	<500
2.	Total Suspended solids	ppm	Nil
3.	Iron as Fe	ppm as Fe	<0.1
4.	Reactive Silica as SiO2	ppm as SiO2	<1.0
5.	Chloride as Cl	ppm as Cl	<200
6.	Sodium	ppm as Na	<150
7.	pH at 25 deg C	---	6.0-7.0

Applicable for Type-4

DATE	pH	Cond. (µS/cm)	T.H (ppm)	Ca++ (ppm)	Mg++ (ppm)	M.Alk (ppm)	Cl (ppm)	Res Cl2 (ppm)	TEMP (℃)	Turb (NTU)
01.07.2020	7.1	101	38	26	12	34	14	ND	29	29
02.07.2020	7.1	103	38	26	12	42	12	ND	29	21
03.07.2020	7.1	103	40	26	14	40	12	ND	28	29
04.07.2020	7.1	104	38	26	12	42	12	ND	28	32
06.07.2020	7	99	38	24	14	40	10	ND	28	125
07.07.2020	6.9	97	38	24	14	36	12	ND	28	107
08.07.2020	6.8	108	38	26	12	34	12	ND	29	90
09.07.2020	6.9	112	40	28	12	36	14	ND	28	16
10.07.2020	6.9	106	40	26	14	44	16	ND	28	28
11.07.2020	6.8	101	42	28	14	42	12	ND	28	91
13.07.2020	6.7	100	44	30	14	42	12	ND	28	94
14.07.2020	7	102	44	28	16	42	16	ND	27	60
15.07.2020	6.6	81	34	22	12	34	8	ND	27	512
16.07.2020	6.9	98	44	32	12	36	12	ND	28	110
17.07.2020	6.9	103	38	28	10	44	14	ND	28	48
18.07.2020	7	102	38	26	12	42	12	ND	29	33
20.07.2020	6.8	105	36	26	10	42	12	ND	28	36
21.07.2020	7	101	38	26	12	44	14	ND	29	44
22.07.2020	7	102	40	28	12	42	14	ND	29	44
23.07.2020	6.8	110	40	28	12	40	14	ND	28	92
24.07.2020	6.9	101	42	26	16	44	16	ND	27	61
25.07.2020	7	98	40	24	16	42	14	ND	27	61
27.07.2020	7	108	40	24	16	42	18	ND	28	31
28.07.2020	7	103	38	24	14	42	16	ND	28	26
29.07.2020	7	103	36	22	14	44	16	ND	28	25

DATE	pH	Cond. (µS/cm)	T.H (ppm)	Ca++ (ppm)	Mg++ (ppm)	M.Alk (ppm)	Cl (ppm)	Res Cl2 (ppm)	TEMP (℃)	Turb (NTU)
01-04-2021	7	108	38	26	12	38	14	ND	27	12
02-04-2021	7.3	110	36	26	10	38	12	ND	27	12
03-04-2021	7.2	109	36	26	10	38	12	ND	28	12
05-04-2021	7.1	109	38	26	12	42	12	ND	28	10
06-04-2021	7.1	109	38	26	12	40	12	ND	28	12
07-04-2021	7.1	109	38	26	12	42	12	ND	28	11
08-04-2021	7	109	38	26	12	40	12	ND	29	12
09-04-2021	7	109	36	26	10	40	12	ND	29	12
10-04-2021	7	108	36	26	10	40	12	ND	29	14
12-04-2021	7	108	36	26	10	40	12	ND	29	13
13-04-2021	7.1	108	38	26	12	40	12	ND	29	12
15-04-2021	7	110	38	26	12	42	12	ND	29	12
16-04-2021	7	108	38	26	12	40	12	ND	29	13
17-04-2021	7.1	108	38	26	12	42	12	ND	29	13
19-04-2021	7	109	36	24	12	40	12	ND	30	12
20-04-2021	7.1	107	36	26	10	42	12	ND	30	13
21-04-2021	7	110	36	26	10	40	12	ND	30	12
22-04-2021	7	112	36	26	10	40	12	ND	30	12
23-04-2021	7	108	36	26	10	40	12	ND	30	12
24-04-2021	7	109	36	26	10	42	10	ND	30	13
26-04-2021	7	108	38	26	12	42	10	ND	30	10
27-04-2021	7	109	38	26	12	36	12	ND	30	10
28-04-2021	7	107	38	26	12	40	12	ND	30	12
29-04-2021	7	110	38	26	12	40	12	ND	31	10
30-04-2021	7	109	36	26	10	42	12	ND	30	12

Table-3

DESIGN CLARIFIED WATER ANALYSIS

S.No	Constituent	As	mg/l (except pH & turbidity)
1.	Calcium	$CaCO_3$	131
2.	Magnesium	$CaCO_3$	52
3.	Sodium + Potassium	$CaCO_3$	65
4.	Total Cations	$CaCO_3$	248
5.	Chloride	$CaCO_3$	20
6.	Sulphate	$CaCO_3$	93
7.	Nitrate	$CaCO_3$	10
8.	Alkalinity	$CaCO_3$	125
9.	Total Anions	$CaCO_3$	248
10.	Iron(total)	Fe	0.3
11.	Total Silica	SiO_2	22
12.	pH value	---	7.0-8.2
13.	Turbidity	NTU	10

Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dozing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.

Table-4

ANALYSIS OF DM WATER

Sl.No.	Characteristics	Value
1.	Silica (Max.)	0.02 ppm as SiO2
2.	Iron as Fe	Nil
3.	Total hardness	Nil
4.	pH value	6.8 to 7.2
5.	Conductivity	Not more than 0.1 μs/cm

Water analysis for Type - 6

CLAUSE NO.	Project Information

Table-4
DESIGN CLARIFIED WATER ANALYSIS

S.No	Constituent	As	mg/l (except pH & turbidity)
1.	Calcium	$CaCO_3$	200.5
2.	Magnesium	$CaCO_3$	92
3.	Sodium + Potassium	$CaCO_3$	96
4.	Total Cations	$CaCO_3$	388.50
5.	Chloride	$CaCO_3$	106
6.	Sulphate	$CaCO_3$	58.5
7.	Alkalinity	$CaCO_3$	224
8.	Total Anions	$CaCO_3$	388.50
9.	Iron(total)	Fe	0.3
10.	Silica	SiO_2	10
11.	pH value	---	7.0-8.5
12.	Turbidity	NTU	10

Note: Clarified water is used for CW system as make up & the CW system is expected to operate at about 5.0 – 5.5 Cycles of Concentration (COC) with suitable chemical treatment program using acid, scale & corrosion inhibitor dozing. As CW blow down water is tapped from CW system, the water quality of CW blow down shall accordingly be arrived by the bidder.

Table-5
ANALYSIS OF DM WATER

ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER

S.No.	Characteristics		Value
i)	Silica (Max.)	-	0.02 ppm as SiO2
ii)	Iron as Fe	-	Nil
iii)	Total hardness	-	Nil
iv)	pH value	-	6.8 to 7.2
v)	Conductivity	-	Not more than 0.1 excluding the effects of free CO_2

SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

STANDARD TECHNICAL SPECIFICATION FOR SELF CLEAING STRAINER

STANDARD QUALITY PLAN

1.00.00 **GENERAL**

This specification covers the Design, Performance and Operational Requirements, Constructional Features, Manufacture, Assembly. Inspection and Testing at the Manufacturer's and/or his Sub-contractor's works and Painting for delivery of Self-Cleaning Strainer (Backwash Type) complete with all accessories as specified hereinafter.

2.00.00 **CODES AND STANDARDS**

2.01.00 The design, materials manufacture, inspection and testing of the Self Cleaning Strainer complete with all accessories, shall comply with the requirements of the latest revisions of the following appropriate codes and standards :

2.01.01 IS/ BS/ DIN/ US Standards regarding pressure vessels, pipes, flanges and others as necessary.

2.01.02 IS/ BS/ DIN/ ASTM Standards for materials specification and testing procedures.

2.01.03 IS/ BS/ DIN/ AWWA Standards for valves and their testing.

2.02.00 In case of any conflict between the above codes/ standards and this specification, the later shall prevail and in case of any further conflict in the matter, the interpretation of the specification by the Engineer shall be final and binding.

3.00.00 **DESIGN AND CONSTRUCTION**

3.01.00 **General Requirements**

3.01.01 Unless otherwise necessary manufacturer's standard and proven models of the Self Cleaning Strainer shall be supplied.

3.01.02 The Self Cleaning Strainer shall be capable of safe, proper and continuous operation. Vibration, noise, mechanical stresses shall be kept within allowable limits specified by relevant codes / standards, in design due attention shall be given to ease of maintenance, repair and cleaning.

3.01.03 Suitable corrosion allowance shall be provided wherever necessary. Adequate provision for future installation of cathodic protection shall be provided.

3.01.04 The Self Cleaning Strainer shall be designed to suit installation in on-line or off-line arrangement as specified in Data Sheet-A.

In the on-line arrangement, the inlet and outlet pipes of the Self Cleaning Strainer shall be in line with each other on the same axis without any off-set between the centre lines of inlet and outlet pipes.
In the off-line arrangement, the Self Cleaning Strainer inlet and outlet pipes shall be at right angle (90°) to each other.

3.02.00 **Performance Requirements**

The Self Cleaning Strainer with all accessories shall be designed and guaranteed to meet the following requirements:-

3.02.01 The Self Cleaning Strainer shall perform satisfactorily under the flow and pressure conditions specified in Data Sheet -A and shall be capable of housing the various forms of debris / sludge i.e., suspended particles / matter, mussels, grass, leaves, wood pieces etc. The performance of the Self Cleaning strainer shall be continuous with minimum number of flushing/ backwashing operations.

3.02.02 The Self Cleaning Strainer shall be designed such that the pressure drop across the Self Cleaning Strainer (i.e., between inlet and outlet connections) under clean conditions and partially (50%) chocked conditions shall not be more than those specified in Data Sheet -A.

3.02.03 Unless otherwise specified in Data Sheet -A, debris discharge / wash water flow rate during flushing/back washing operation shall be limited to 10% of the total flow rate and flushing / backwashing operation shall be completed within a period of maximum three (3) minutes. The pressure drop across the Self Cleaning strainer during flushing/ backwashing operation shall not be more than the pressure drop under partially (50%) chocked condition.

3.02.04 The coarse particles and floating matter accumulating at the filter section/screen are flushed out of the system by the system by the debris flushing / backwash unit such that the pressure drop across the filter after flushing / backwashing, shall not be more than 1.1 times the pressure drop under clean conditions.

3.03.00 **Operational Requirement**

The Self Cleaning Strainer and other accessories shall be designed for the following flushing/backwashing operation modes:

3.03.01 Complete automatic flushing/backwashing operation effected by the following:-

- differential pressure measuring system at a pre-determined differential pressure across the filter screen.
- adjustable timer (0-24 hours)
- push button (for manual initiation of sequential flushing / backwashing)

3.03.02 Manual operation in the event of failure of control system.

3.04.00 **Filter Housing/ Body**

3.04.01 The Self Cleaning Strainer housing/body shall be designed and manufactured as per the applicable codes for pressure vessels. It shall house the filter section / screen assembly and shall have flanged inlet, outlet, flushing/ debris discharge openings and pressure measuring tappings etc.

3.04.02 In design of SCS housing/ body due attention shall be given for easy removal and replacement of filter section / screen assembly.

3.04.03 The Self Cleaning Strainer shall be provided with inspection hole with bolted cover.

3.04.04 The SCS body / housing shall be provided with vent and drain connections with isolating valves. It shall be possible to drain unfiltered and filtered water.

3.04.05 If specified in Data Sheet-A, filter body/housing shall be epoxy painted.

3.05.00 **Filter Section / Screen assembly.**

3.05.01 The Self Cleaning Strainer section/screen shall be designed for the maximum differential pressure across the filter and shall be securely positioned by a supporting cage and shall be securely mounted in the housing or body.

3.05.02 The perforation/mesh size of the strainer section shall not be more than that specified in Data Sheet-A.

3.05.03 The arrangement of the Strainer section shall be such that the forced accumulation of debris on the filter screen / section shall be minimum.

3.06.00 **Differential Pressure Measuring System**

3.06.01 The Self Cleaning Strainer shall be provided with a measuring system for differential pressure across the filter section/screen, to check debris accumulation and to initiate flushing/ backwashing operation. This shall consist of a differential pressure transmitter for automatic flushing operation, a differential pressure gauge for manual observation with adequate number of taping with isolating valves and equalising valves.

3.06.02 The contacts for differential pressure transmitter and for differential pressure gauge shall be independent so that in the event of failure of one, the other is available.

3.06.03 The differential pressure measuring system shall be provided with D.P. transmitter & DPG of remote seal arrangement..

3.07.00 **Flushing / Backwash Unit. :**

3.07.01 The Self Cleaning Strainer shall be provided with suitable flushing/backwash unit (to be installed at ground floor) and debris discharge/ backwash outlet valve with associated actuator to flush out the accumulated debris/ sludge.

3.07.02 The flushing pump shall be provided with mechanical seals to the extent possible. If gland packing is provided it should be of good quality to prevent leakage of water bran pump glands.

3.07.03 The flushing arrangement shall be either fixed type with flushing valves or a rotating debris extractor.

3.07.04 If any water is to be injected for backwashing the filter section/screen, water shall be taken from down-stream side of the filter section/ screen. Necessary pump, valves and piping for water injection shall be supplied.

3.07.05 View glass to be provided in debris outlet pipe to monitor the flushing of debris.

3.08.00 **Valves**

The flushing valves (if any,) the debris discharge/backwash outlet valve, isolation, vent and drain valves shall conform to appropriate codes / standards.

3.09.00 **Instrumentation and Control System**

3.09.01 Complete instrumentation and control system for automatic flushing/ backwashing operation, protection, interlocking, indication/ annunciation of high differential pressure and other malfunctions etc. shall be provided. This shall consist of adequate operational hardware, local control panel and interconnecting control and power cabling between the control panel and the Self Cleaning strainer and its associated electrical devices.

3.09.02 The control panel shall house all necessary instruments, indicating/ annunciation lamps, alarms, differential pressure indicator, timer, function selector switches, relays, protection and interlocking systems, start/stop push buttons, counter to register number of flushing operations etc., and shall be complete with internal wiring. In addition to the above, the control panel shall meet the requirements of the enclosed specification.

3.09.03 All instrumentation shall be of reputed make and shall meet the requirement of the enclosed specification.

3.10.00 **Actuators :**

The actuators for flushing arrangement and debris discharge valve shall be electric motor operated and shall meet the requirements of the enclosed specification. The actuators shall be provided with auxiliary hand-wheel for manual operation in the event of power failure.

3.11.00 **Electric Motors :**

The drive motors for differential pressure measuring system flushing pump and water injected pump (if applicable) shall confirm to the requirements of the enclosed specification.

3..12.00 **Other Accessories.**

3.12.01 Counter flanges, complete with gaskets, bolts and nuts etc., shall be supplied for the filter inlet, outlet connections and all other terminal points. Fabrication, dimensions and drilling of the flanges shall conform to the codes/standards specified in Data Sheet-A/ Section -C.

3.12.02 Self Cleaning Filter shall be provided with suitable lifting arrangement for handling during erection and maintenance.

4.00.00 **SHOP INSPECTION AND TESTS**

4.01.00 **General:**

4.01.01 Manufacturer shall conduct all tests and stage inspections as per the approved quality plan to ensure that the Self Cleaning strainer and other accessories shall conform to the requirements of this specification and of the applicable codes/ standards.

4.01.02 All materials used for manufacture/fabrication of the Self Cleaning Strainer shall be of tested quality. Relevant test certificates for chemical analysis, mechanical tests and heat treatment shall be made available before the final shop inspection. In case the relevant test certificates are not available, the manufacturer shall arrange to carry out the necessary tests as per approved quality plan and applicable codes at his cost, for which samples shall be identified by BHEL's representative.

4.01.03 All shop tests shall be conducted in the presence of BHEL's representative and test certificates / reports for the same shall be furnished to BHEL for approval.

4.01.04 Qualification of welding procedures and welders shall be as per ASME B&PV Code, Section-IX / applicable codes.

4.02.00 **Filter Housing / Body**

4.02.01 Chemical analysis, mechanical tests shall be carried out on housing/body, strainer/ screen, strainer/ screen shaft and other appurtenances as per the applicable material specification standards.

4.02.02 All butt welded joints shall be subjected to radiographic / ultrasonic testing as per applicable codes. However all welded joints shall be subjected to 100% magnetic particle / penetrant testing to ensure freedom from defects.

4.03.00 **Rubber Lining (as applicable)**

Rubber lining shall be subjected to surface crack test, 100% spark and hardness tests and shall be checked for layer thickness, defects etc.

4.04.00 **Filter Section/Screen assembly**

Supporting cage and filter section/screen materials shall be tested for chemical properties. Checks shall be carried out for perforation/mesh size, defects etc.

4.05.00 **Flushing / Backwash Unit**

4.05.01 Material of various components of the flushing/Backwash Unit shall be tested for chemical and mechanical properties.

4.05.02 Hollow shaft of backwash rotor shall be ultrasonically tested as per ASTM-A 388 for internal flaws. Penetrant test shall be carried out for surface flaws.

4.06.00 **Valves**

Inspection and testing of valves including leakage test shall be carried out as per the requirements of the applicable standards. Correlating test certificates for materials of the valve components shall be furnished.

4.07.00 **Flanges**

4.07.01 In case of fabricated flanges, all the welds shall be subjected to 100% radiography as per ASME B&PV code, section VIII, Division-1.

4.07.02 In case of forged flanges, ultrasonic testing shall be carried out as per ASTM-A 388.

4.07.03 If the thickness of the plate used for flanged is 40mm or more the same shall be checked ultrasonically as per ASTM-A435 to demonstrate the absence of lamination and lack of fusion etc.

4.07.04 Chemical and mechanical test certificates shall be furnished for flange materials.

4.07.05 Flanges shall be checked for edge preparation, fit up and satisfactory working with matching parts.

4.08.00 All materials for various nozzles, seals, pipes, gaskets, nuts bolts etc., shall be of tested quality and correlating test certificates for chemical and mechanical properties shall be furnished.

4.09.00 **Dimensional Checks**

Dimensional checks of various components of the Self Cleaning Strainer shall be carried out as per the drawings approved by BHEL. Alignment and fit up of movable parts shall be checked.