Pre-Qualification Criteria as per GeM

PI No: 241140151 – PACKAGE 1 **Date: 10.04.2025**

Product: Butterfly Valves with Manual operator for Water Service.

Participation Eligibility Criterion

Experience Criteria (in Years as described below) [0/1/2/3]: 01

1. Definition of same/similar category product:
   For present procurement, same/ similar product will be **Cast double offset Butterfly Valves with Manual / Electrical operator for Water Service.**

2. **Documents to be submitted:**
   Bidders to submit PO copy & dispatch details (SRN from NPCIL) for **01** financial year, for the same/similar products, as defined above in last **15** financial years from bid opening date for size **600 NB** or above for supply to any of **NPCIL** project.

Additional criterion (to be verified at the time of technical evaluation)

Past performance (In percentage) [0 to 80%]: NA

1. Definition of same/similar category product: -
   Not Applicable

2. Documents to be submitted: -
   Not Applicable

Exemption to verified MSME for Experience [Yes / No]: NO

Exemption to verified Startups for Experience [Yes / No]: NO

Note: MSME relaxation will be applicable for SMALL and MICRO industry only as per policy circular no 1(2) (1)/2016-MA dtd. 10/03/2016 from Ministry of Micro, Small & Medium Enterprises.

NOTE: -

1.0 Only Indian Manufacturer are allowed to participate in the tender. Document in support of their claim of being an Indian Manufacturer to be furnished.

2.0 Vendor to submit credential in format provided for NPCIL approval. Offer of only NPCIL approved vendor shall only be considered.

Prepared by: -	Checked by: -	Approved by: -
Kunj Bihari Singh	Mayank Jain	S. P. Vatsa
Dy. Mgr.-CDE	Sr. Mgr.-CDE	AGM-CDE

Pre-Qualification Criteria as per GeM

PI No: 241140151 – PACKAGE 2 **Date: 10.04.2025**

Product: Butterfly Valves with Electrical operator for Water Service.

Participation Eligibility Criterion
Experience Criteria (in Years as described below) [0/1/2/3]: 02

1. Definition of same/similar category product:
   For present procurement, same/ similar product will be **Cast double offset Butterfly Valves with Electrical operator for Water Service.**

2. **Documents to be submitted:**
   Bidders to submit documents, as defined below in last **15** years from bid opening date
   a) **1 No** PO & dispatch details (Invoice/e-way Bill) for the same/similar products, as defined above, for size **1600 NB** or above for supply to any Central/State Govt. organization/PSU/Public listed/reputed Private company.
   b) **1 No** PO & dispatch details (SRN from NPCIL) for the same/similar products, as defined above, in different Financial Year from above (2a) supply, for size **600 NB** or above for supply to any of **NPCIL** project.

Additional criterion (to be verified at the time of technical evaluation)

Past performance (In percentage) [0 to 80%]: NA

1. Definition of same/similar category product: -
   Not Applicable

2. Documents to be submitted: -
   Not Applicable

Exemption to verified MSME for Experience [Yes / No]: NO

Exemption to verified Startups for Experience [Yes / No]: NO

Note: MSME relaxation will be applicable for SMALL and MICRO industry only as per policy circular no 1(2) (1)/2016-MA dtd. 10/03/2016 from Ministry of Micro, Small & Medium Enterprises.

NOTE: -

1.0 Only Indian Manufacturer are allowed to participate in the tender. Document in support of their claim of being an Indian Manufacturer to be furnished.

2.0 Vendor to submit credential in format provided for NPCIL approval. Offer of only NPCIL approved vendor shall only be considered.

Prepared by: -	Checked by: -	Approved by: -
Kunj Bihari Singh	Mayank Jain	S. P. Vatsa
Dy. Mgr.-CDE	Sr. Mgr.-CDE	AGM-CDE

SPECIFIC CONFIRMATION REQUIRED FROM SUPPLIER
(To be filled, signed & stamped by Bidder)

BF VALVE ALONG WITH ACTUATOR AND GEARBOX

S. NO.	TECHNICAL REQUIREMENTS	BIDDER CONFIRMATION
1.	Bidder Status: Indian Manufacturer	YES / NO
2.	Document w.r.t. Pre-Qualification Criteria (PQR) enclosed	YES / NO
3.	Clearly understood Scope of Supply mentioned in Technical Specification	YES / NO
4.	Capability to manufacture mentioned Butterfly Valve.	YES / NO
5.	Size and Design Pressure - As per Technical Specification	YES / NO
6.	Valve Class Rating	
7.	Design and Testing Requirement - As per Technical Specification	YES / NO
8.	Body Short Body Flanged Ends, Casted Double Eccentric Offset Disc Design with optimum Torque Requirement, Over Travel Limit Stoppers	YES / NO
9.	End Connection Standard : AWWA C-207	
10.	All points as mentioned in **Annexure-I** of enquiry shall be complied.	YES / NO
11.	Surface Preparation, Paint and Marking - As per Technical Specification	YES / NO
12.	Inspection - As per Approved QAP	YES / NO
13.	Packing & Dispatch - As per Technical Specification	YES / NO
14.	Body, Disc, Shaft, Seat ring, Seal, Seal Retaining Ring, Bearing, Flanges, Internal Hardware, External Hardware and other Material - As per Technical Specification	YES / NO
15.	GA, Cross Section & Data Sheet attached as per Technical Specification	YES / NO
16.	Torque Calculation, Actuator Sizing Calculation, Shaft Calculation, shaft to disc connection pins sizing, Body Thickness Calculation and Valve characteristic & pressure drop curves attached as per Technical Specification	YES / NO

SPECIFIC CONFIRMATION REQUIRED FROM SUPPLIER
(To be filled, signed & stamped by Bidder)

BF VALVE ALONG WITH ACTUATOR AND GEARBOX

S. NO.	TECHNICAL REQUIREMENTS	BIDDER CONFIRMATION
17.	POD test certificates attached as per Applicable standard. In case, the same is not available, Bidder to confirm to carry out POD during contract stage.	YES / NO
18.	Sub-vendors for BOIs including Actuator/GearBox - As per End Customer approved list	YES / NO
19.	Vendor to Submit/Confirm Name of Sub-vendors for BOIs including Actuator/Gearbox in line with above Point.	YES / NO
20.	Filled **Format** (If Not Approved by ultimate customer **NPCIL**) along with supporting documents. Offer of only **NPCIL** approved vendor shall be considered.	YES / NO
21.	Sealed & Signed copy of this specification and enclosed Annexures & Schedules attached	YES / NO
22.	Clearly specify Deviation (if any) from BHEL's requirement in attached Compliance certificate, otherwise it will be presumed that the offer is in line with our requirements.	YES / NO

Name of bidder:

Sign & stamp

COMPLIANCE CERTIFICATE

[To be submitted by participating bidder selecting either option (A) or (B)]

Bid No. _____

[A] NO TECHNICAL DEVIATION:

OR

[B] TECHNICAL DEVIATION: as listed below
(Deviations listed elsewhere shall not be considered)

1……
2……
3……

Name of bidder:

Sign & stamp

SUB-VENDOR QUESTIONNAIRE

i.	*Item/Scope of Sub-contracting*			
ii.	*Address of the registered office*	*Details of Contact Person (Name, Designation, Mobile, Email)*		
iii.	*Name and Address of the proposed Sub-vendor's works where item is being manufactured*	*Details of Contact Person: (Name, Designation, Mobile, Email)*		
iv.	*Annual Production Capacity for proposed item/scope of sub-contracting*			
v.	*Annual production for last 3 years for proposed item/scope of sub-contracting*			
vi.	***Details of proposed works***			
1.	*Year of establishment of present works*			
2.	*Year of commencement of manufacturing at above works*			
3.	*Details of change in Works address in past (if any)*			
4.	*Total Area*			
	Covered Area			
5.	*Factory Registration Certificate*	*Details attached at Annexure – F2.1*		
6.	*Design/ Research & development set-up (No. of manpower, their qualification, machines & tools employed etc.)*	*Applicable / Not applicable if manufacturing is as per Main Contractor/purchaser design) Details attached at Annexure – F2.2 (if applicable)*		
7.	*Overall organization Chart with Manpower Details (Design/Manufacturing/Quality etc)*	*Details attached at Annexure – F2.3*		
8.	*After sales service set up in India, in case of foreign sub-vendor (Location, Contact Person, Contact details etc.)*	*Applicable / Not applicable Details attached at Annexure – F2.4*		
9.	*Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any*	*Details attached at Annexure – F2.5*		
10.	*Sources of Raw Material/Major Bought Out Item*	*Details attached at Annexure – F2.6*		
11.	*Quality Control exercised during receipt of raw material/BOI, in-process , Final Testing, packing*	*Details attached at Annexure – F2.7*		

SUB-VENDOR QUESTIONNAIRE

12.	***Manufacturing facilities*** ***(List of machines, special process facilities, material handling etc.)***	***Details attached at Annexure – F2.8***
13.	***Testing facilities*** ***(List of testing equipment)***	***Details attached at Annexure – F2.9***
14.	***If manufacturing process involves fabrication then-*** ***List of qualified Welders*** ***List of qualified NDT personnel with area of specialization***	***Applicable / Not applicable*** ***Details attached at Annexure – F2.10*** ***(if applicable)***
15.	***List of out-sourced manufacturing processes with Sub-Vendors' names & addresses***	***Applicable / Not applicable*** ***Details attached at Annexure. –F2.11*** ***(if applicable)***
16.	***Supply reference list including recent supplies***	***Details attached at Annexure – F2.12*** ***(as per format given below)***

Project/ package	*Customer Name*	*Supplied Item (Type/Rating/Model /Capacity/Size etc)*	*PO ref no/date*	*Supplied Quantity*	*Date of Supply*

17.	***Product satisfactory performance feedback letter/certificates/End User Feedback***	***Attached at annexure - F2.13***
18.	***Summary of Type Test Report (Type Test Details, Report No, Agency, Date of testing) for the proposed product (similar or higher rating)*** ***Note:- Reports need not to be submitted***	***Applicable / Not applicable*** ***Details attached at Annexure – F2.14*** ***(if applicable)***
19.	***Statutory / mandatory certification for the proposed product***	***Applicable / Not applicable*** ***Details attached at Annexure – F2.15*** ***(if applicable)***
20.	***Copy of ISO 9001 certificate (if available)***	***Attached at Annexure – F2.16***
21.	***Product technical catalogues for proposed item (if available)***	***Details attached at Annexure – F2.17***

Name:		***Desig:***		***Sign:***		***Date:***	

Company's Seal/Stamp:-

1	2	3	4	5			6	7	8			9	10	11		12	13	14
SL NO.	PROJECT	SIZE mm (NB)	OPERATION	VALVE TYPE	BODY AND DISC MATERIAL	TECHNICAL SPECIFICATION	SERVICE	END CONNECTION	DESIGN			NORMAL FLOW M3/HR	MAX FLOW M3/HR	MATCHING PIPE OD x THK		MAIN VALVES QTY WITHOUT SPARES (NOS.)	COMMISSIONING SPARES (SETS)	MANDATORY SPARES (SETS)
									DESIGN PRESSURE KG/CM2(G)	TEMP (DEG ^{0} C)	MIN AWWA CLASS			MM	MM			
1	NPCIL KAIGA	450	MANUALLY OPERATED	CAST	A216 WCB	PC/E/08016	WATER SERVICE	FLANGED	10	55	150B	Later	Later	457	9.5	**16**	16	1
2	NPCIL KAIGA	500	MANUALLY OPERATED	CAST	A216 WCB	PC/E/08016	WATER SERVICE	FLANGED	10	55	150B	Later	Later	508	9.5	**10**	10	1
3	NPCIL KAIGA	600	MANUALLY OPERATED	CAST	A216 WCB	PC/E/08016	WATER SERVICE	FLANGED	10	55	150B	Later	Later	610	9.5	**10**	10	1
4	NPCIL KAIGA	450	MANUALLY OPERATED	CAST	A216 WCB	PC/E/08016	WATER SERVICE	FLANGED	6	50	150B	Later	Later	457	9.5	**16**	16	1
5	NPCIL KAIGA	700	MANUALLY OPERATED	CAST	A216 WCB	PC/E/08016	WATER SERVICE	FLANGED	6	50	150B	Later	Later	711	9.5	**4**	4	1
6	NPCIL KAIGA	1200	MANUALLY OPERATED	CAST	A216 WCB	PC/E/08016	WATER SERVICE	FLANGED	6	50	150B	Later	Later	1219	12	**2**	2	1

1	2	3	4	5			6	7	8			9	10	11		12	13	14
									DESIGN					MATCHING PIPE OD x THK				
SL NO.	**PROJECT**	**SIZE mm (NB)**	**OPERATION**	**VALVE TYPE**	**BODY AND DISC MATERIAL**	**TECHNICAL SPECIFICATION**	**SERVICE**	**END CONNECTION**	**DESIGN PRESSURE KG/CM2(G)**	**TEMP (DEG ^{0} C)**	**MIN AWWA CLASS**	**NORMAL FLOW M3/HR**	**MAX FLOW M3/HR**	**MM**	**MM**	**MAIN VALVES QTY WITHOUT SPARES (NOS.)**	**COMMISSIONING SPARES (SETS)**	**MANDATORY SPARES (SETS)**
7	NPCIL KAIGA	1800	ELECTRICALLY OPERATED	CAST	Ductile Iron A536	PC/E/08017	WATER SERVICE	FLANGED	6.5	50	150B	Later	Later	1829	14	**24**	24	1
8	NPCIL KAIGA	500	ELECTRICALLY OPERATED	CAST	A216 WCB	PC/E/08017	WATER SERVICE	FLANGED	10	55	150B	Later	Later	508	9.5	**2**	2	1

NOTE - (1) Commissioning spares Sets and Mandatory Spare Sets defined in PC-E-08016 And PC-E-08017.

(2) 1 Set of quantity means, quantity applicable for 01 no. of BF Valve Assembly

(3) Valve Tag No, Line No, Service Description as Per Technical Specification PC-E-08016 Annexure-B for Item 1 to 6 And PC-E-08017 Annexure-B for Item 7 to 8

(4) Test on Valve as per class

List of items in the scope of supply:

(i) Complete Assembly of Butterfly Valve
(ii) BF valve Operator
(iii) Both side companion Flanges along-with associated Gasket & Hardware
(iv) Complete foundation items (e.g., foundation plate, associated fasteners, etc.) required for erection of Butterfly Valve.
(v) Commissioning and Mandatory spares (Details below)

Commissioning Spares of Valve(Enq ITEM-2,5,8,11,14,17,20,23):

Item	Qty Required
DOOR/DISC SEAL	1 Set for each valve
SHAFT O-RING	1 Set for each valve

Mandatory Spares of Valves (Enq ITEM-3,6,9,12,15,18,21,24):

Item	Qty Required
DOOR/DISC SEAL	2 Set for each valve
GLAND PACKING	2 Set for each valve
SHAFT O-RING	2 Set for each valve
FLANGE GASKET	2 Set for each valve
SHEARING PIN AND DOWEL PIN	2 Set for each valve
DISC SEAL CLAMPING RING	1 Set for each set of identical valves.
BODY SEAT RING	1 Set for each set of identical valves.
SHAFT BEARING	1 Set for each set of identical valves.
SEAT AND SEAL CLAMPING FASTENER	20 % of Total Quantity

NOTE - “Set” refers to the total no. quantity applicable for each valve
e.g. if one valve has four “O” ring seals, one set refers to four “O” ring seals

DC NO.: PC/E/08016

TECHNICAL SPECIFICATION

FOR

MANUALLY OPERATED BUTTERFLY VALVES

PROJECT: KAIGA ATOMIC POWER PROJECT UNIT 5&6

1 SCOPE

This specification is intended to cover the technical requirements of design, construction features, manufacture, assembly, inspection, testing, packing, supply, delivery and performance guarantee of Electrically operated butterfly valves for light water systems. The valves supplied shall confirm to the specification detailed below and the applicable Valve specification sheet attached along with this specification as **Annexure – A**.

2 CONTENTS

Sr. No	Title	Page No
1.0	Scope	1
2.0	Contents	1
3.0	Applicable Codes and Standards	1
4.0	General Design Requirements	2
5.0	Vendor List and Approval	4
6.0	Material and Workmanship	4
7.0	Inspection and Testing	5
8.0	Performance Guarantee	9
9.0	Scope of Supply	9
10.0	Special Cleaning, Protection & Painting	10
11.0	Identification and Marking	10
12.0	Packaging and Dispatch	11
13.0	Data / Documents to be submitted	11
14.0	Quality Assurance Plan	13
15.0	Deviation	13
Annexure - A	Valve Specification Sheet (VSS)	4 pages
Annexure - B	Manually operated butterfly valves list	2 pages
Annexure - C	Data Sheet – Format to be filled and submitted by the Vendor along with the bid	2 pages

3 APPLICABLE CODES AND STANDARDS

The Butterfly Valve shall conform to the latest edition as on bid due date of all applicable requirements of the following national / international standards as specified in the individual valve specification sheet. Nothing in this specification shall be construed to relieve the supplier of this responsibility.

(i) American National Standards Institution (ANSI) standards
(ii) American Petroleum Institute (API) standards
(iii) ASME Boiler and Pressure Vessel Code (BPVC)
(iv) American Water Works Association (AWWA) standards
(v) American Society for Testing Materials (ASTM) standards
(vi) Bureau of Indian Standards (BIS)
(vii) Manufacturer's Standards Specification (MSS) – Standard Practices

In the event of any conflict between provision of this specification and the documents listed above, this specification shall govern.

4 GENERAL DESIGN REQUIREMENTS

4.1 Requirements for Valves

4.1.1 All valves shall conform to the design standard mentioned in VSS.

4.1.2 Materials of construction shall be as per VSS. All materials which are not specified in valve specification sheets shall be subject to the approval.

4.1.3 The valve design shall be according to the requirements of codes/specifications indicated in VSS. The valves shall be designed for various loads viz. dead weight, pressure, etc.

4.1.4 Valves shall be closing in clockwise direction wherever applicable.

4.1.5 The design of valves shall ensure a streamlined passage and low pressure drop.

4.1.6 The Disc seal and Seal Clamping ring shall be designed such that replacement can be made without valve Disc removal.

4.1.7 The valves shall be suitable for installation with the shaft in any position.

4.1.8 The valves shall function smoothly without sticking, rubbing, vibrating or scouring in any position of the valve.

4.1.9 Any special tools & tackles, etc. if required, shall be in Manufacturer's scope.

4.1.10 Valve Body and Bonnet

All valves shall be of full bore design. The rating of the valves shall be as specified on the appropriate valve specification sheets and shall be in accordance with the pressure rating as per VSS.

Valve body internals should be streamlined and there shall be no pockets or stress concentration points. Valve body minimum wall thickness shall be governed by AWWA C 504 / AWWA C 516 as specified in VSS.

The end connections dimensions of valves shall be equal to those defined in standard as specified in VSS. Valve body end connections shall be as per VSS.

If the valves are specified as flanged ends, the flanges shall have diameter and drilling in accordance with standard as specified in VSS. Flanges shall be cast integral with the valve body. The facing shall be specified in valve specification sheet.

Fasteners shall be provided with positive locking device.

4.1.11 Valve Trim

The design and material for valve trim shall provide maximum protection against the effect of corrosion, corrosion-erosion, galling, and leakage.

Valve disc should be of such a design as to keep the seats tights when valve body is subjected to pipeline stresses, temperature changes and pressures.

Valve seats, plugs, and discs must be hard-faced using a cobalt-free nickel-based alloy with a minimum hardness difference of 50 BHN between seat and disc/plug, meeting ASME Section IX standards. Surface finish on the stem should be 0.8 micron RMS (Root Mean Square) or better.

The hardness of the trim material shall be BHN 250 (Rockwell C-25) minimum. The material to be used as mentioned in VSS

4.1.12 Packing materials

Packing materials should be suitable for the fluid handled and the valve design should facilitate easy replacement of packing.

4.1.13 Valve Stem Sealing Arrangement

The method of valve stem sealing shall be as defined in the VSS.

4.1.14 Threaded Fasteners

The material used for all pressure bearing threaded fasteners shall conform to that specified in VSS.

All threads shall be unified series screw threads and shall conform to ISO equivalent to ANSI B 1.1. All threaded fasteners shall be provided with positive locking device. Frictional locking devices are not acceptable.

4.1.15 Valve Position Indicators

The valve shall be provided with a mechanical position indicator and a scale to indicate 'open', 'close' or intermediate positions of the disc. A positive stopper arrangement shall also be provided at the two extreme positions (open & close). For valves with operators the position indicator may be provided on the operator.

4.1.16 Provision shall be made for lifting heavy components by means of lugs, eye bolts or standard device of the manufacturer(s).

4.1.17 The valves shall be capable of safe, proper and continuous operation under the specified conditions.

4.1.18 Parts subjected to wear, corrosion or other deterioration requiring adjustment, inspection or repair shall be accessible and capable of reasonably convenient removal when required.

4.1.19 Bolts, nuts and gaskets shall conform to the material standards specified in the VSS. Studs and screws for valves shall conform to the applicable Indian Standard except otherwise noted. All nuts and bolts have hexagonal heads, unless otherwise specified.

4.1.20 All carbon steel forgings shall be tested by magnetic particle test in accordance with ASTM E-109/138 and basis of acceptance shall be ASTM E-125.

4.2 Interchangeability

Components and spare parts of valves, operators etc. shall be mutually interchangeable among valves of one type and size.

5 VENDOR LIST AND APPROVAL

Supplier shall note that if Ultimate customer NPCIL approval is not there / not available, then the respective vendor offer will not be considered for further processing / ordering for the supply of Butterfly Valve against this Enquiry being Ultimate Customer NPCIL contractual requirement.

Vendors not yet approved by Ultimate customer NPCIL shall provide following details for onward transmission to NPCIL in time bound manner in the offer itself in single submission duly signed & certified in all the pages with signature & seal for BHEL / NPCIL review & considerations for approval.

1. Duly filled Sub-Supplier Questionnaire.
2. Factory Registration Certificate.
3. Overall organization Chart with Manpower details (Design, Manufacturing, Quality etc)
4. Supply reference list of the Sub-Supplier indicating similar product supply order reference no., customer name, rating of product, date/year of supply, date/year of commissioning.
5. List of Manufacturing Equipment available with sub vendor.
6. List of Testing Equipment available with sub vendor with photos.
7. Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any.
8. Details of Outsourced Manufacturing Processes, if any.
9. Quality control exercised during receipt, in-process & final inspection.
10. List of all major items / components to be manufactured in house as procured from sub vendors bought out items.
11. Vendor facilities established at their respective works, process capability, process stabilization, QC systems followed, experience list with end user credentials.
12. Documents other than above if required by customer (end user) shall be submitted by vendor as and when asked for.

6 MATERIAL AND WORKMANSHIP

Material and standard parts shall be as specified in Valve specification sheet. Material and standard parts which are not specifically designated herein or in VSS shall be of good quality and in accordance with the best practice in the manufacture of valves and operators.

Material shall be suitable for duty intended and shall be procured from Client approved supplier.

Vendor List in line with client approved supplier shall be submitted for BHEL reference along with enquiry and reviewed Vendor List shall be used in case of award of contract/PO.

Gearbox for operation of BF valves shall be procured from following **Client approved sub-vendors**:

- M/s Auma, India
- M/s Rotork, India
- M/s Auma, Germany
- M/s Rotork, UK

However, Bidder can also propose any other reputed supplier. The acceptance of the proposed supplier shall be subject to approval of BHEL & Client (End User). Bidder shall provide credentials of the proposed supplier in the format as stated in "Clause-Vendor List and Approval"

Workmanship shall be in accordance with the best practice, adequate to ensure satisfactory operation, service life and ease of maintenance in accordance with the requirements of this Specification.

7 INSPECTION AND TESTING

7.1 General

The Manufacturer shall be responsible to perform all the examination and testing specified herein. Examination and testing shall be conducted as per duly approved Quality Assurance Plan (QAP). The manufacturer shall prepare QAP for respective valve meeting the specification requirements and shall submit for approval.

All inspection and testing for valves & operator shall be carried out BHEL's/ Customer's representative as per approved QAP.

BHEL's/ Customer's representative shall be given access to the shop where butterfly valves are being manufactured and tested. All test records shall be made available to BHEL's/ Customer's representative.

7.2 Examination on Test Failure

In the event of failure of any part of the equipment to meet any inspection or test requirement specified herein, the Manufacturer shall obtain permission from BHEL/Customer before repair or subsequent use of such equipment or part.

The Supplier shall obtain permission from BHEL/Customer before repair or subsequent use of such equipment or part except in the case of repair of a casting. However, the repair technique and all radiographs shall be subject to approval by the BHEL/Customer.

If any repairs or redesigns are likely to affect the results of tests or work previously complete, appropriate re-inspection and retesting shall be conducted.

7.3 **Material Tests**

All materials designated as in accordance with an ASME/ASTM specification shall be subject to all mill tests for chemical and physical properties as required by the appropriate ASME/

ASTM Specifications.

Proof in the form of certified test reports or mill certificates that the required tests have been carried out at the source will be acceptable with proper co-relation, but if these are not available, the tests shall be performed by Manufacturer.

7.4 Scope of Inspection and Test

7.4.1 Castings

7.4.1.1 Material for body and Disc castings shall be tested as per requirements of relevant specification.

7.4.1.2 Valve body casting shall be hydrostatically tested at pressures standard as per individual specification. Duration of the tests shall not be less than 10 minutes. The casting shall show no leak.

7.4.1.3 Examination of casting which are repaired by welding shall be carried out as per provisions of ANSI-B 16.34 para 8.4

7.4.1.4 Weld repairs of casting shall be carried out with prior approval of BHEL/Customer.

7.4.2 Forgings

All Forgings shall be tested as per requirements of relevant material specification.

7.4.3 Machined surfaces of stems, discs and seats shall be examined by liquid penetrant method.

7.4.4 Bolts and Nuts

Bolts and nuts shall be tested as per the provisions of relevant material specification.

7.4.5 Rubber parts used in the valve shall be visually inspected. Shore hardness test of the rubber parts shall be carried out and certificate of compliance for the rubber components shall be submitted.

7.4.6 For all other materials, supplier shall maintain suitable quality control to ensure their compliance with requirements of specification.

7.5 Liquid Penetrant Examination

Before assembly of the valve, the following components shall be subjected to Liquid Penetrant Examination

(a) All external and accessible internal surfaces of the pressure bearing parts of the body (where these surfaces have been previously inspected by the manufacturer of the castings

or forgings, such inspection need not be repeated except in areas which have been subsequently machined).

(b) The complete surface area of valve discs including the facings.

(c) Complete surface area of the stem.

(d) All weld repairs.

Liquid Penetrant Examination shall be performed in accordance with the procedure specified in Article 6 of ASME Section V Code.

(a) Cleaning agents, penetrant and developers shall not contain sulphur and halogen more than 25 ppm each.

(b) All traces of penetrant and developer shall be removed from the work on completion of inspection.

(c) The temperature of the area to be inspected shall be between 10°C and 40°C.

(d) The acceptance standard shall be:

(i) Valve seats and valve stems shall be defect free.

(ii) For other areas, all indications shall be evaluated in terms of the acceptance standards of the referencing Code Section, as mentioned in the VSS.

(iii) Broad areas of fluorescence or pigmentation which could mask indications of discontinuities are unacceptable, and such areas shall be cleaned and re-examined.

7.6 Test on Assembled Valves

Following tests shall be carried out on the valves after assembly.

7.6.1 Hydrostatic tests and air leak tests

All valves after assembly shall be hydrostatically tested for body and seat closure at the pressures as indicated in the VSS. Air leak test for seat shall also be carried out. Duration of body shell test shall be as specified in VSS.

7.6.2 For body tests no leakage or wetting of external surfaces is permitted. For seat closure test leakage through the disc and seat shall be not more than that permitted by **API-598**. During seat closure tests external forces that affect seat leakage shall not be applied to valve ends. While testing for seat leakage no undue forces or additional leverage shall be used.

7.6.3 Gland Packing Hydrotest

During the hydrostatic testing of the shell, the inner and outer gland packing shall be tested separately to ascertain the effectiveness of the gland sealing arrangement. Stem packing shall be tested as follows and shall meet the requirements stated herein.

(i) The pressure on the valve shall first be raised to the maximum service pressure stated in the valve specification sheet. The packing gland shall be adjusted so that there is no visible leakage past the packing.

(ii) The pressure on the valve shall then be raised to full hydrostatic test pressure to complete the shell and seat test. The packing gland shall be adjusted only if necessary, to meet the following requirements. On valves with operators, minor leakage is

permitted at the packing gland. On valves with conventional hand wheels, no leakage shall be permitted at the packing gland.

(iii) The packing gland of valves with operators shall be retested at the maximum service pressure stated on the Valve Specification Sheet. No visible leakage at the packing gland shall be permitted.

7.6.4 Acceptance Standard for Hydrotest

Acceptance criteria for Hydrotest shall be as specified in VSS.

7.6.5 Air Leak Seat Test

Where specified on the valve specification sheet, the valve shall be tested for air leakage across the seat. An air pressure shall be applied on the underside of the valve seat with the valve seating surface in a horizontal plane and in closed position. The other side of the valve seat shall be filled with water at atmospheric pressure. The air test pressure shall be as specified in VSS. The duration of the test shall be not less than 5 min or as specified in VSS. The maximum permissible leakage shall be as specified in VSS. This test shall be conducted subsequent to hydrostatic test.

7.7 Test of Valve Gearbox

7.7.1 Type test shall be carried out, wherever specified in the specification sheet.

7.7.2 Each Gearbox must be performance tested and individual test certificates shall be supplied.

7.7.3 In addition, the test certificate shall record details of specification such as gear ratios, closing direction etc.

7.8 Test on Assembled Valve and Functional Test

7.8.1 All manual valves shall be subjected to functional qualification test at the design service pressure as stated on the individual valve specification sheet.

7.8.2 The complete valve assembly along with the gearbox shall be operated with disc differential pressure from fully closed to fully opened and vice versa. Checks shall be included in QAP for free movement of valve door, open/ close timings, operation of limit/ torque switches and indicator.

7.9 All valves hydrostatically tested shall be completely drained prior to despatch.

7.10 For all valves supplier shall submit:

(a) Pressure test certificates.
(b) Foundry/Forge shop material certificates for castings/forgings properly corelating.
(c) Compliance certificates that all materials of construction for the various components are in conformity with the specification.
(d) Test certification of gearbox and assembled valve actuator.

(e) Certificates etc. shall be submitted to the BHEL's/ Customer's representative during final inspection. The valves shall not be shipped before proper shipping release note is obtained from the BHEL/ Customer. Examination and inspection by BHEL/ Customer shall not relieve the supplier of his contractual responsibility to furnish valves in compliance with specification and meeting specified guarantees.

8 PERFORMANCE GUARANTEE

The Manufacturer shall guarantee the material & workmanship of all components as well as operation of equipment as per specification sheet & approved QAP. The valves and all accessories shall be designed so as to guarantee an easy disassembling and maintenance.

9 SCOPE OF SUPPLY

Butterfly Valves shall be supplied with all accessories required for successful operation after installation at site. Any requirement, if not specifically mentioned in this specification, for ensuring completeness of supply & successful installation and valve operation at site shall be considered by the bidder & included in the offer. BF Valve price shall be quoted for complete scope (i.e., BFV ready for use condition) which shall comprise of items mentioned below:

9.1 List of items in the scope of supply:

(i) Complete Assembly of Butterfly Valve
(ii) BF valve Operator
(iii) Both side companion Flanges along-with associated Gasket & Hardware
(iv) Complete foundation items (e.g., foundation plate, associated fasteners, etc.) required for erection of Butterfly Valve.
(v) Commissioning and Mandatory spares (Details below)

9.2 Spares details

The Supplier shall provide each of the following components as spare parts for each set of identical valves.

9.2.1 Commissioning Spares

Commissioning spare includes following items:

Sr. No.	Item Description	Unit of Measure	Qty Required
1.	Disc seal	set	1 set for each valve
2.	Shaft 'O' ring seals	set	1 set for each valve

9.2.2 Mandatory Spares

Mandatory spare includes following items:

Sr. No.	Item Description	Unit of Measure	Qty Required
1.	Door / Disc Seal	set	2 set for each valve
2.	Gland Packing	set	2 set for each valve
3.	Shaft 'O' ring seals	set	2 set for each valve
4.	Flange Gasket	set	2 set for each valve
5.	Shearing pins and dowel pins	set	2 set for each valve
6.	Disc seal clamping ring	set	1 Set for each set of identical valves.
7.	Body seat ring (replaceable type)	set	1 Set for each set of identical valves.
8.	Shaft Bearing	Set	1 Set for each set of identical valves.
9.	Seat and seal clamping fastener	Set	20 % of Total Quantity for each valve

(1 set means quantity required for one valve)

10 SPECIAL CLEANING, PROTECTION AND PAINTING

All valves shall be free of mill scale. The inside of all the valves shall be free of sand, dirt and other foreign matter. All openings shall be adequately sealed.

A sack containing silica gel desiccant shall be firmly attached to the inner surface on the cover of one end of each valve.

The outside surface of the valves shall be given two shop coat of red lead primer or approved equivalent primer as required to prevent corrosion, after release has been given for painting and before dispatch. Final painting shall be carried out as per painting requirements specified in valve specification sheet.

11 IDENTIFICATION & MARKING

The valve body and attached plate shall be marked with the information called for in MSS-SP.

The following data concerning the valve shall be shown on the valve or the valve name plate.

1) Manufacturer's name, year of manufacture.
2) Valve rating, pressure and temperature.
3) Body size
4) Body material
5) Type
6) Preferred direction of Flow

The following data concerning the gearbox shall be shown. The gearbox name plate may be combined with the valve name plate.

1) Manufacturer's name, year of manufacture.
2) Model No
3) Serial number
4) Size

In addition, each valve shall be attached with an identification metal tag with corrosion resistant wire. The identification tag shall show valve identification as per the individual specification sheets / valve list /Tender Document. The same number shall appear on any loose accessory component packaged and shipped with the valve.

12 PACKAGING AND DISPATCH:

12.1 All **valves** shall be prepared for shipment in accordance with the instructions stated below:

(a) After testing, each valve shall be drained, cleaned, dried completely and suitably protected in sturdy wooden box so as to avoid damage during transit and storage.
(b) All exterior surfaces shall be painted with suitable paint in accordance with painting requirements specified in specification.
(c) The valves shall be so packed and protected as not to suffer corrosion, deterioration or damage of any sort during shipment to end storage at the project.
(d) All components shall be packed, suitably boxed and protected from damage in transit to the site in India. Equipment shall be prepared for a transit period exceeding two months.
(e) The construction and lining of the boxes shall provide protection for their contents. The packaging shall include adequate cushioning, blocking, bracing, skidding, hoisting and the tie down provisions. The packaging shall be subjected to the approval of BHEL/ Customer.

12.2 Companion Flanges shall be drilled as per the specified standard and all exposed surfaces shall be protected by fitting 20 mm thick plywood blank flange held in place with 4 bolts and sealed with a blank gasket of natural rubber or equivalent so that they are not damaged during transportation.

12.3 No shipment shall be done unless shipping release is issued by the purchaser in writing and for shipment.

13 DATA / DOCUMENTS TO BE SUBMITTED

13.1 Data / Documents to be submitted along with the bid

(a) Filled applicable Data sheets
(b) Catalogues
(c) Outline drawings for each type of valve and operator assembly, indicating various dimensions, part details and material of construction, details of ends, location of support etc. Clearance above or below the centre line of valve bodies to remove inner parts from valve bodies shall also be indicated.

(d) Typical sectional details for each type of valves, showing internal arrangement and parts list shall be submitted along with the bid.
(e) Torque & shaft sizing calculation.
(f) Curves showing valve opening flow coefficient (C_V) characteristic / pressure drop curves / K_v values and flow characteristics curves shall also be submitted.
(g) Valid POD test certificates as per standard of offered butterfly valves for offered seat design & MOC along with test reports consisting of test procedure and test set up. In case, the same is not available, Bidder to confirm to carry out POD during contract stage as per approved proof of design procedure.
(h) List of sub-vendors' for BOIs includes CS/SS Plates, Castings & Forgings, Hardware, Rubber Seals, Bearing/Bush etc. including gearbox supplier(s).
(i) Deviation, if any.
(j) Sealed & Signed copy of this specification and enclosed Annexures & Schedules as acceptance to technical requirements.

13.2 Documents to Be Submitted After Placement of Order / At Final Stage / Inspection History Document

(a) Following **Documents and procedure** shall be submitted for approval by the **NPCIL**.

(i) General Arrangement (GA) drawings showing valve construction, MOC of parts (BOM), counter flanges, dimensions, O/C timing, design & testing requirement, other technical details and Sectional details for each type of valves, showing internal arrangement.
(ii) Painting specification / procedure inline with NPCIL Painting specification.
(iii) Shaft diameter selection, shaft to disc connection pins sizing, operator sizing and opening, closing torque calculation in line with AWWA-C-504
(iv) Gearbox datasheet
(v) Valve specification datasheet.
(vi) Quality assurance plan (QAP)
(vii) NDT procedures
(viii) Manufacturing sequence plan
(ix) Performance Test Procedure
(x) Proof of design procedure for butterfly valves
(xi) Type test Procedure for Valve gearbox
(xii) Hydro body and seat test procedure
(xiii) Air leak body and seat test procedure
(xiv) Welding and weld repair procedure, where applicable.
(xv) Heat treatment procedure, where applicable.
(xvi) Packing Procedures

Documents other than above if required by customer (end user) shall be submitted by vendor as and when asked for.

(b) Material Test Certificates, Shop Test Reports & Certificates along with other inspection reports as per approved QAP shall be furnished to BHEL before dispatch.

(c) Bound History dockets - five sets each comprising the following documents.

The supplier shall be required to submit the following documents along with despatch of equipment

(i) P.O. and Sub-Order copies.
(ii) Approved as built drawings.
(iii) Approved QAP's
(iv) Approved Procedures.
(v) Material test certificates.
(vi) NDT Reports.
(vii) Hydrostatic Test Certificates.
(viii) Performance Test Procedure and Performance Test Reports with curves / other test reports.
(ix) Dimensional Reports.
(x) Shipping release copies.
(xi) All Design Concession reports if any.
(xii) Guarantee and Compliance Certificate.

(d) Five hard and soft copies / sets Operation and Maintenance Manuals covering Preventive maintenance requirements and procedures.
(e) Five hard and soft copies of Reproducibles for each of the drawings, and drawings on magnetic media preferably on CD.

14 QUALITY ASSURANCE PLAN

The QA plan of the work clearly showing the Customer hold points, review points of tenderer has to be submitted along with the offer. Quality assurance plan for the work covered by this specification shall be as per the Customer approved QAP.

15 DEVIATION

Deviation from specification requirement (if any), needs to be clearly mentioned & listed in Separate sheet along with techno commercial offer. It is BHEL/Customer prerogative to accept such deviation during offer evaluation.

Annexure - A

GENERAL REQUIREMENT:

Parameter	Specification
Valve Type	Butterfly Valve with Flanged End
Size	Refer Annexure-B
Pressure Rating	150 LBS
Valve Type	Cast Valve, Valve Fabricated from Plate are not acceptable.
Design Standards	AWWA C504
Testing Standards	AWWA C504
Flanged Ends Standards	AWWA C-207 CLASS-D

DESIGN REQUIREMENT:

Description	Requirement
Body	Short Body Flanged Ends, Casted Double Eccentric Offset Disc Design with Low Torque Requirement, Over Travel Limit Stoppers
Disc/Door	Single cast piece
Stem	Blow out Proof Design (Refer Note 5&6)
Stem Seal Type	"O" Ring/"U" Cup Seal (Material: Viton)
Bearing Material	Phosphor Bronze/Other material having self-lubricating properties
Disc Seal Type	Musical Note Type (Refer Note-8)
Seal Clamping Ring	Single piece
Body Seat Ring	Single piece
Handwheel	Yes (Material: ASTM A216 WCB/CCS)
End Connections	Flat face, serrated finish, as per AWWA C207 Class D. (Refer Note-12)

MATERIAL OF CONSTRUCTION:

Component	Material Specification
Body	Refer Annexure-B
Disc/Door	Refer Annexure-B
Stem	ASTM A479 TP 410
Bearing Material	Phosphor Bronze/Other material having self-lubricating properties
Body Seat Ring	ASTM A479 TP 316
Seal Clamping Ring	ASTM A479 TP 316
Seal	EPDM, Shore Hardness 65 ±5.
Internal Fastener	Bolts: ASTM 193 GR B8M ASTM 194 GR 8M
Internal hardware	Pin/Locknuts/etc shall made of SS316

External Hardware	Bolts: SA 193 GR B7 (Phosphated) & Nuts: SA 194 GR 2H (Phosphated)

MANUAL OPERATOR REQUIREMENT:

Parameter	Specification
Gear Box Ratio	As per Manufacturer
Body/Casing Material	Material: Gray cast iron/ Malleable iron
Gears	Material: Stainless Steel/ Alloy Steel
Shaft	Material: ASTM A 479 TP 410
Seal/ "O" Ring	Material: Viton
Gearbox Fill	Material: As per Manufacturer
Bushes	Material: As per Manufacturer

SERVICE CONDITIONS:

Parameter	Value
Fluid	Water
Design Pressure [kg/cm²(g)]	Refer Annexure-B
Maximum Pressure	Manufacturer to specify
Max Temperature	50°C
Flow (max)	Refer Annexure-B
Flow (Normal)	Refer Annexure-B
Specific Gravity @ 25°C	0.997
Viscosity @ 25°C	0.89 cP
Δ P (kg/cm²)	Manufacturer to specify
C_v	Manufacturer to specify
Valve Characteristics	Manufacturer to specify
Disc Differential Pressure [kg/cm² (g)]	Same as Design Pressure of The System.

TESTING REQUIREMENTS*:

Test Type	Test Pressure [kg/cm²(g)]	Duration (min)	Acceptance Criteria
Hydrostatic Body Test	As per Valve Class	10	No Visible Leakage
Hydrostatic Seat/Disc Leak Test (Both Direction)	As per Valve Class	5	Drop Tight
Air Leak Seat Test	As per Valve Class	5	Bubble Tight

*NPCIL to witness test as per Approved QAP

1. TYPE TEST – VALVE

POD Test	Standards
Disc Strength, Cycle Test, Torque Test	AWWA C504

2. TYPE TEST – GEAR BOX

Type Test on Gearbox	On One Gearbox	NPCIL to witness one Valve & 100% by BHEL/BHEL TPIA
Routine Test on Gearbox	100 %	

3. OTHERS TESTS

All Raw Material	Physical and Chemical T.C. from Manufacturer with Heat No. Correlation
Shaft Dimension Test	UT with 2 mm preferential Flat Bottom Back Hole
Dimensional Checks	100% by Package contractor & Sample Check by Purchaser

NOTES:

1. Manufacturer shall submit QAP and obtain NPCIL approval before manufacturing.
2. Shaft diameter selection, shaft to disc connection pins sizing, operator sizing and opening, closing torque calculation to be submitted in line with AWWA-C-504 for NPCIL verification
3. Bi-directional bubble tight seal is required.
4. Double eccentric valves with low torque requirement.
5. Stem should not come in contact with flowing fluid (i.e. It should remain dry).
6. High strength stub shaft shall be provided with minimum 1.5 times dia. Penetration into disc hubs with close tolerance fit and secured with adequate number and capacity lock pins.
7. Valve face to face dimensions shall be as per AWWA - C-504-short.
8. Sealing seat (EPDM Material) shall be either on body or on disc and the shape shall be musical note type giving reliable leak tightness. Valves Sealing seat shall be in-situ replaceable type.
9. Integral position indicator on the stem and top mounting flanges for positive disc position identification shall be provided.
10. Integral cast adjustable travel stop is to be provided on valve body.
11. Only Cast valves are acceptable. Valves fabricated from plates are not acceptable.
12. Valve ends to suit AWWA C-207, class-D for sizes beyond 300 NB
13. Valve shall be suitable for both “on-off” as well as “throttling “applications under maximum differential pressure.
14. Valves should be able to perform in vertical and horizontal orientation, upstream or downstream of elbows and pipe reducers.
15. Surface preparation as per SA 2.5, External and internal painting shall be done as per NPCIL specification **PC-E-615 in line with Clause 6.6**, which shall be submitted for NPCIL approval.

16. External painting of cast iron & carbon steel surfaces shall be carried out as per package specification.
17. Maximum valve torque requirement shall be worked out considering bi-directional sealing, disc differential pressure equivalent to valve rating pressure and hydraulic forces on disc due to change of direction of flow within one Dia length upstream or downstream. Vendor shall submit valve operator sizing calculations for approval
18. Gearbox shall be totally enclosed & lubricated.

ANNEXURE-B

Sl. No	Valve TAG Nos.	Line no.	Service Description	Size (NB)	Opern.	Design Press. Kg/cm²(g)	Design Temp. (°C)	Normal Flow (M^3/Hr)	Maximum Flow (M^3/Hr)	Valve Body & Disc Material	Pipe OD (mm)	Pipe Thk. (mm)	QTY (No)	Remarks
1	$-7315-V-8532	450-ACW-1-7135-8636	PHE-1 INLET	450	MANUALLY OPERATED	10	55	Later	Later	ASTM A216 CCS(WCB)	457	9.5	2	1 for each Unit
2	$-7315-V-8533	450-ACW-1-7135-8637	PHE-1 OUTLET	450	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	457	9.5	2	1 for each Unit
3	$-7315-V-8534	450-ACW-1-7135-8638	PHE-2 INLET	450	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	457	9.5	2	1 for each Unit
4	$-7315-V-8535	450-ACW-1-7135-8642	PHE-2 OUTLET	450	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	457	9.5	2	1 for each Unit
5	$-7315-V-8536	450-ACW-1-7135-8643	PHE-3 INLET	450	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	457	9.5	2	1 for each Unit
6	$-7315-V-8537	450-ACW-1-7135-8644	PHE-3 OUTLET	450	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	457	9.5	2	1 for each Unit
7	$-7315-V-8545	450-ACW-1-7135-8645	PHE-4 INLET	450	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	457	9.5	2	1 for each Unit
8	$-7315-V-8550	450-ACW-1-7135-8646	PHE-4 OUTLET	450	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	457	9.5	2	1 for each Unit
9	$-7315-V-8511	500-ACW-1-7135-8516	ACW PUMP-1 DISCHARGE	500	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	508	9.5	2	1 for each Unit
10	$-7315-V-8501	500-ACW-1-7135-8524	ACW PUMP-2 DISCHARGE	500	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	508	9.5	2	1 for each Unit
11	$-7315-V-8502	500-ACW-1-7135-8539	ACW PUMP-3 DISCHARGE	500	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	508	9.5	2	1 for each Unit
12	$-7315-V-8605	500-ACW-1-7135-8669	GENERATOR HYDROGEN COOLER INLET	500	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	508	9.5	2	1 for each Unit
13	$-7315-V-8607	500-ACW-1-7135-8675	GENERATOR HYDROGEN COOLER OUTLET	500	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	508	9.5	2	1 for each Unit
14	$-7315-V-8507	600-ACW-1-7135-8512	ACW PUMP-1 SUCTION	600	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	610	9.5	2	1 for each Unit
15	$-7315-V-8512	600-ACW-1-7135-8520	ACW PUMP-2 SUCTION	600	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	610	9.5	2	1 for each Unit
16	$-7315-V-8522	600-ACW-1-7135-8535	ACW PUMP-3 SUCTION	600	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	610	9.5	2	1 for each Unit

Sl. No	Valve TAG Nos.	Line no.	Service Description	Size (NB)	Opern.	Design Press. Kg/cm²(g)	Design Temp. (°C)	Normal Flow (M^3/Hr)	Maximum Flow (M^3/Hr)	Valve Body & Disc Material	Pipe OD (mm)	Pipe Thk. (mm)	QTY (No)	Remarks
17	$-7315-V-8523	600-ACW-1-7135-8541	ACW PUMP DISCHARGE TAP OFF TO CF CLR, TO CLR, BFP CLR & SGBD CLR	600	MANUALLY OPERATED	10	55	Later	Later	ASTM A216 CCS(WCB)	610	9.5	2	1 for each Unit
18	$-7315-V-8530	600-ACW-1-7135-8655	ACW PUMP DISCHARGE TAP OFF TO GENERATOR COOLERS	600	MANUALLY OPERATED	10	55			ASTM A216 CCS(WCB)	610	9.5	2	1 for each Unit
19	$-7185-V-1009	450-W-1-7185-1005	PHE-1 INLET	450	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	457.0	9.5	2	1 for each Unit
20	$-7185-V-1014	450-W-1-7185-1014	PHE-1 OUTLET	450	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	457.0	9.5	2	1 for each Unit
21	$-7185-V-1008	450-W-1-7185-1008	PHE-2 INLET	450	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	457.0	9.5	2	1 for each Unit
22	$-7185-V-1013	450-W-1-7185-1013	PHE-2 OUTLET	450	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	457.0	9.5	2	1 for each Unit
23	$-7185-V-1007	450-W-1-7185-1007	PHE-3 INLET	450	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	457.0	9.5	2	1 for each Unit
24	$-7185-V-1012	450-W-1-7185-1012	PHE-3 OUTLET	450	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	457.0	9.5	2	1 for each Unit
25	$-7185-V-1006	450-W-1-7185-1006	PHE-4 INLET	450	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	457.0	9.5	2	1 for each Unit
26	$-7185-V-1011	450-W-1-7185-1011	PHE-4 OUTLET	450	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	457.0	9.5	2	1 for each Unit
27	$-7185-V-1019	700-W-1-7185-1001	CONTROL BUILDING INLET	700	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	711.0	9.5	2	1 for each Unit
28	$-7185-V-1025	700-W-1-7185-1025	CONTROL BUILDING OUTLET	700	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	711.0	9.5	2	1 for each Unit
29	$-7185-V-1015	1200-W-1-7185-1016	ASW RETURN HEADER	1200	MANUALLY OPERATED	6	50			ASTM A216 CCS(WCB)	1219.0	12.0	2	1 for each Unit

$ - For Unit Numbers, Specification of respective Project Shall Be Referred to Identify Unit Numbers.

ANNEXURE - C

VALVE DATA SHEET FOR BUTTERFLY VALVES

GENERAL	VALVE TYPE					VALVE SPEC. SH. NO.: *Project / USI / Number / VSS* REV.NO. PAGE: 1 of 2	
	SIZE						
	APPL. SPECN.						
	DESIGN STD.						
BODY	PRESSURE RATING	:					
	END CONNECTION	:					
	MATERIAL : BODY	:				LINING	:
	BOLTS	:				NUTS	:
	CONST. FEATURES	:					
	HAND WHEEL / LEVER	:				MATERIAL	:
	SHAFT SEAL	:				MATERIAL	:
	SHAFT BEARING	:				MATERIAL	:
TRIM	STEM	:				MATERIAL	:
	DISC	:				MATERIAL	:
	SEAT ON BODY / DISC	:				MATERIAL	:
	INTERAL HARDWARE	:				MATERIAL	:
	DISC POSITION IDENTIFICATION	:					

SERVICE COND	FLUID	:	WATER				MAX	MIN	
	PRESSURE (Kg/cm^2 g)	:	DESIGN	10	OPERATING				
	TEMP (deg C)	:	MAX		MIN		NORMAL		
	FLOW (m^3/hr)	:	MAX.		MIN		NORMAL		
	DENS. (Kg/m^3) @ 15 ^{0} C	:							
	DISC DIFFERENTIAL PRESSURE (Kg/cm^2 g)	:							
	Δ P	:	#						
	C_V	:	#						

	DESCRIPTION	PRESSURE (Kg/cm^2 g)	DURATION IN MINUTES	APPLICABLE CLAUSE OF SPECIFICATION	
INSP&TESTS	HYDROSTATIC SEAT / DISC (BI-DIRECTIONAL) TEST				
	AIR LEAK BODY TEST				
	AIR LEAK SEAT TEST				
	DISC STRENGTH AS DESIGN PROOF TEST				TYPE TEST ON ONE VALVE ONLY, OTHERWISE TEST CERTIFIACATE TO BE FURNISHED
	VALVE & ACT. PERFORMANCE TEST				
	ACTUATOR TEST				
	FUNCTIONAL QUALIFICATION TEST				
	ALL RAW MATERIAL				
	MATERIAL CHECKS				

	ACCESSORIES		NOT APPLICABLE		APPLICABLE	
ACCESSORIES	LIMIT SWITCHES FOR PNEMATIC ACTUATORS	OPEN		CLOSE		
	CHAIN WHEEL		FLOOR STAND			
	EXTN. BONNET		SUPPORT LUGS			
	FLANGES		OTHERS			

NOTES :

1. VENDOR TO INDICATE VALUES FOR ITEMS MARKED (#)
2. MANUFACTURER TO SUBMIT QAP & OBTAIN NPC'S APPROVAL BEFORE MANUFACTURING.
3. TESTING SHALL BE AS PER AWWA C-504.
4. VALVE SHALL BE CAPABLE OF BI-DIRECTIONAL BUBBLE TIGHT SEALING.
5. VALVES SHOULD BE ABLE TO PERFORM WHEN DRIVE SHAFT & DISC ARE IN VERTICAL AND HORIZONTAL ORIENTATION, UPSTREAM OR DOWNSTREAM OF ELBOWS AND PIPE REDUCER.
6. STEM SHOULD NOT COME IN CONTACT WITH FLOWING FLUID (i.e. IT SHOULD REMAIN DRY).
7. INTEGRAL POSITION INDICATOR ON THE STEM AND TOP MOUNTING FLANGES FOR DISC POSITION IDENTIFI-CATION SHALL BE PROVIDED.
8. VALVE SHALL HAVE BLOW OUT PROOF STEM DESIGN FEATURE TO ARREST STEM COMING OUT FROM DISC DURING MAINTENANCE
9. HIGH STRENGTH STUB SHAFT SHALL BE PROVIDED WITH MINIMUM 1.5 TIMES DIA. PENETRATION INTO DISC HUBS WITH CLOSE TOLERANCE FIT AND SECURED WITH ADEQUATE NUMBER AND CAPACITY LOCK PINS.
10. SHAFT DIAMETER SELECTION, SHAFT TO DISC CONNECTION, PIN SIZING, OPERATOR SIZING SHALL BE IN-LINE WITH AWWA-C 504. CALCULATIONS TO BE SUBMITTED FOR APPROVAL.

DC NO.: PC/E/08017

TECHNICAL SPECIFICATION

FOR

POWER OPERATED BUTTERFLY VALVES

PROJECT: KAIGA ATOMIC POWER PROJECT UNIT 5&6

1 SCOPE

This specification is intended to cover the technical requirements of design, construction features, manufacture, assembly, inspection, testing, packing, supply, delivery and performance guarantee of Electrically operated butterfly valves for light water systems. The valves supplied shall confirm to the specification detailed below and the applicable Valve specification sheet attached along with this specification as **Annexure – A**.

2 CONTENTS

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3 APPLICABLE CODES AND STANDARDS

The Butterfly Valve shall conform to the latest edition as on bid due date of all applicable requirements of the following national / international standards as specified in the individual valve specification sheet. Nothing in this specification shall be construed to relieve the supplier of this responsibility.

(i) American National Standards Institution (ANSI) standards
(ii) ASME Boiler and Pressure Vessel Code (BPVC)
(iii) American Water Works Association (AWWA) standards
(iv) Institute of Electrical and Electronics Engineers (IEEE) standards
(v) American Society for Testing Materials (ASTM) standards

(vi) Bureau of Indian Standards (BIS)

(vii) Manufacturer's Standards Specification (MSS) – Standard Practices

In the event of any conflict between provision of this specification and the documents listed above, this specification shall govern.

4 GENERAL DESIGN REQUIREMENTS

4.1 Requirements for Valves

4.1.1 All valves shall conform to the design standard mentioned in VSS.

4.1.2 Materials of construction shall be as per VSS. All materials which are not specified in valve specification sheets shall be subject to the approval.

4.1.3 The valve design shall be according to the requirements of codes/specifications indicated in VSS. The valves shall be designed for various loads viz. dead weight, pressure, etc.

4.1.4 Valves shall be closing in clockwise direction wherever applicable.

4.1.5 The design of valves shall ensure a streamlined passage and low pressure drop.

4.1.6 The Disc seal and Seal Clamping ring shall be designed such that replacement can be made without valve Disc removal.

4.1.7 The valves shall be suitable for installation with the shaft in any position.

4.1.8 The valves shall function smoothly without sticking, rubbing, vibrating or scouring in any position of the valve.

4.1.9 Any special tools & tackles, etc. if required, shall be in Manufacturer's scope.

4.1.10 Valve Body and Bonnet

All valves shall be of full bore design. The rating of the valves shall be as specified on the appropriate valve specification sheets and shall be in accordance with the pressure rating as per VSS.

Valve body internals should be streamlined and there shall be no pockets or stress concentration points. Valve body minimum wall thickness shall be governed by AWWA C 504 / AWWA C 516 as specified in VSS.

The end connections dimensions of valves shall be equal to those defined in standard as specified in VSS. Valve body end connections shall be as per VSS.

If the valves are specified as flanged ends, the flanges shall have diameter and drilling in accordance with standard as specified in VSS. Flanges shall be cast integral with the valve body. The facing shall be specified in valve specification sheet.

Fasteners shall be provided with positive locking device.

4.1.11 Valve Trim

The design and material for valve trim shall provide maximum protection against the effect of corrosion, corrosion-erosion, galling, and leakage.

Valve disc should be of such a design as to keep the seats tights when valve body is subjected to pipeline stresses, temperature changes and pressures.

Valve seats, plugs, and discs must be hard-faced using a cobalt-free nickel-based alloy with a minimum hardness difference of 50 BHN between seat and disc/plug, meeting ASME Section IX standards. Surface finish on the stem should be 0.8 micron RMS (Root Mean Square) or better.

The hardness of the trim material shall be BHN 250 (Rockwell C-25) minimum. The material to be used as mentioned in VSS

4.1.12 Packing materials

Packing materials should be suitable for the fluid handled and the valve design should facilitate easy replacement of packing.

4.1.13 Valve Stem Sealing Arrangement

The method of valve stem sealing shall be as defined in the VSS.

4.1.14 Threaded Fasteners

The material used for all pressure bearing threaded fasteners shall conform to that specified in VSS.

All threads shall be unified series screw threads and shall conform to ISO equivalent to ANSI B 1.1. All threaded fasteners shall be provided with positive locking device. Frictional locking devices are not acceptable.

4.1.15 Valve Position Indicators

The valve shall be provided with a mechanical position indicator and a scale to indicate 'open', 'close' or intermediate positions of the disc. A positive stopper arrangement shall also be provided at the two extreme positions (open & close). For valves with operators the position indicator may be provided on the operator.

4.1.16 Provision shall be made for lifting heavy components by means of lugs, eye bolts or standard device of the manufacturer(s).

4.1.17 The valves shall be capable of safe, proper and continuous operation under the specified conditions.

4.1.18 Parts subjected to wear, corrosion or other deterioration requiring adjustment, inspection or repair shall be accessible and capable of reasonably convenient removal when required.

4.1.19 Bolts, nuts and gaskets shall conform to the material standards specified in the VSS. Studs and screws for valves shall conform to the applicable Indian Standard except otherwise noted. All nuts and bolts have hexagonal heads, unless otherwise specified.

4.1.20 All carbon steel forgings shall be tested by magnetic particle test in accordance with ASTM E-109/138 and basis of acceptance shall be ASTM E-125.

4.2 Interchangeability

Components and spare parts of valves, operators, actuators etc. shall be mutually interchangeable among valves of one type and size.

4.3 Requirements for Electrical Operators

Refer Valve specification sheet and Specific technical specifications attached with this for electrical valve actuator.

5 VENDOR LIST AND APPROVAL

Supplier shall note that if Ultimate customer NPCIL approval is not there / not available, then the respective vendor offer will not be considered for further processing / ordering for the supply of Butterfly Valve against this Enquiry being Ultimate Customer NPCIL contractual requirement.

Vendors not yet approved by Ultimate customer NPCIL shall provide following details for onward transmission to NPCIL in time bound manner in the offer itself in single submission duly signed & certified in all the pages with signature & seal for BHEL / NPCIL review & considerations for approval.

1. Duly filled Sub-Supplier Questionnaire.
2. Factory Registration Certificate.
3. Overall organization Chart with Manpower details (Design, Manufacturing, Quality etc)
4. Supply reference list of the Sub-Supplier indicating similar product supply order reference no., customer name, rating of product, date/year of supply, date/year of commissioning.
5. List of Manufacturing Equipment available with sub vendor.
6. List of Testing Equipment available with sub vendor with photos.
7. Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any.
8. Details of Outsourced Manufacturing Processes, if any.
9. Quality control exercised during receipt, in-process & final inspection.
10. List of all major items / components to be manufactured in house as procured from sub vendors bought out items.
11. Vendor facilities established at their respective works, process capability, process stabilization, QC systems followed, experience list with end user credentials.
12. Documents other than above if required by customer (end user) shall be submitted by vendor as and when asked for.

6 MATERIAL AND WORKMANSHIP

Material and standard parts shall be as specified in Valve specification sheet. Material and standard parts which are not specifically designated herein or in VSS shall be of good quality and in accordance with the best practice in the manufacture of valves and operators.

Material shall be suitable for duty intended and shall be procured from **Client approved supplier.**

Vendor List in line with **client approved supplier** shall be submitted for BHEL reference along with enquiry and reviewed Vendor List shall be used in case of award of contract/PO.

Electrical actuators with its secondary gearbox for operation of BF valves shall be procured from following **Client approved sub-vendors**:

- M/s Auma, India
- M/s Rotork, India
- M/s Auma, Germany
- M/s Rotork, UK

However, Bidder can also propose any other reputed supplier. The acceptance of the proposed supplier shall be subject to approval of BHEL & Client (End User). Bidder shall provide credentials of the proposed supplier in the format as stated in “Clause-Vendor List and Approval”

Workmanship shall be in accordance with the best practice, adequate to ensure satisfactory operation, service life and ease of maintenance in accordance with the requirements of this Specification.

7 INSPECTION AND TESTING

7.1 General

The Manufacturer shall be responsible to perform all the examination and testing specified herein. Examination and testing shall be conducted as per duly approved Quality Assurance Plan (QAP). The manufacturer shall prepare QAP for respective valve meeting the specification requirements and shall submit for approval.

All inspection and testing for valves & actuators shall be carried out BHEL’s/ Customer’s representative as per approved QAP.

BHEL’s/ Customer’s representative shall be given access to the shop where butterfly valves are being manufactured and tested. All test records shall be made available to BHEL’s/ Customer’s representative.

7.2 Examination on Test Failure

In the event of failure of any part of the equipment to meet any inspection or test requirement specified herein, the Manufacturer shall obtain permission from BHEL/Customer before repair or subsequent use of such equipment or part.

The Supplier shall obtain permission from BHEL/Customer before repair or subsequent use of such equipment or part except in the case of repair of a casting. However, the repair technique and all radiographs shall be subject to approval by the BHEL/Customer.

If any repairs or redesigns are likely to affect the results of tests or work previously complete, appropriate re-inspection and retesting shall be conducted.

7.3 Material Tests

All materials designated as in accordance with an ASME/ASTM specification shall be subject to all mill tests for chemical and physical properties as required by the appropriate ASME/ASTM Specifications.

Proof in the form of certified test reports or mill certificates that the required tests have been carried out at the source will be acceptable with proper co-relation, but if these are not available, the tests shall be performed by Manufacturer.

7.4 Scope of Inspection and Test

7.4.1 Castings

7.4.1.1 Material for body and Disc castings shall be tested as per requirements of relevant specification.

7.4.1.2 Valve body casting shall be hydrostatically tested at pressures standard as per individual specification. Duration of the tests shall not be less than 10 minutes. The casting shall show no leak.

7.4.1.3 Examination of casting which are repaired by welding shall be carried out as per provisions of ANSI-B 16.34 para 8.4

7.4.1.4 Weld repairs of casting shall be carried out with prior approval of BHEL/Customer.

7.4.2 Forgings

All Forgings shall be tested as per requirements of relevant material specification.

7.4.3 Machined surfaces of stems, discs and seats shall be examined by liquid penetrant method.

7.4.4 Bolts and Nuts

Bolts and nuts shall be tested as per the provisions of relevant material specification.

7.4.5 Rubber parts used in the valve shall be visually inspected. Shore hardness test of the rubber parts shall be carried out and certificate of compliance for the rubber components shall be submitted.

7.4.6 For all other materials, supplier shall maintain suitable quality control to ensure their compliance with requirements of specification.

7.5 Liquid Penetrant Examination

Before assembly of the valve, the following components shall be subjected to Liquid Penetrant Examination

(a) All external and accessible internal surfaces of the pressure bearing parts of the body (where these surfaces have been previously inspected by the manufacturer of the castings or forgings, such inspection need not be repeated except in areas which have been subsequently machined).
(b) The complete surface area of valve discs including the facings.
(c) Complete surface area of the stem.
(d) All weld repairs.

Liquid Penetrant Examination shall be performed in accordance with the procedure specified in Article 6 of ASME Section V Code.

(a) Cleaning agents, penetrant and developers shall not contain sulphur and halogen more than 25 ppm each.
(b) All traces of penetrant and developer shall be removed from the work on completion of inspection.
(c) The temperature of the area to be inspected shall be between 10°C and 40°C.
(d) The acceptance standard shall be:
    (i) Valve seats and valve stems shall be defect free.
    (ii) For other areas, all indications shall be evaluated in terms of the acceptance standards of the referencing Code Section, as mentioned in the VSS.
    (iii) Broad areas of fluorescence or pigmentation which could mask indications of discontinuities are unacceptable, and such areas shall be cleaned and re-examined.

7.6 Test on Assembled Valves

Following tests shall be carried out on the valves after assembly.

7.6.1 Hydrostatic tests and air leak tests

All valves after assembly shall be hydrostatically tested for body and seat closure at the pressures as indicated in the VSS. Air leak test for seat shall also be carried out. Duration of body shell test shall be as specified in VSS.

7.6.2 For body tests no leakage or wetting of external surfaces is permitted. For seat closure test leakage through the disc and seat shall be not more than that permitted by **API-598**. During

seat closure tests external forces that affect seat leakage shall not be applied to valve ends. While testing for seat leakage no undue forces or additional leverage shall be used.

7.6.3 Gland Packing Hydrotest

During the hydrostatic testing of the shell, the inner and outer gland packing shall be tested separately to ascertain the effectiveness of the gland sealing arrangement. Stem packing shall be tested as follows and shall meet the requirements stated herein.

(i) The pressure on the valve shall first be raised to the maximum service pressure stated in the valve specification sheet. The packing gland shall be adjusted so that there is no visible leakage past the packing.

(ii) The pressure on the valve shall then be raised to full hydrostatic test pressure to complete the shell and seat test. The packing gland shall be adjusted only if necessary, to meet the following requirements. On valves with operators, minor leakage is permitted at the packing gland. On valves with conventional hand wheels, no leakage shall be permitted at the packing gland.

(iii) The packing gland of valves with operators shall be retested at the maximum service pressure stated on the Valve Specification Sheet. No visible leakage at the packing gland shall be permitted.

7.6.4 Acceptance Standard for Hydrotest

Acceptance criteria for Hydrotest shall be as specified in VSS.

7.6.5 Air Leak Seat Test

Where specified on the valve specification sheet, the valve shall be tested for air leakage across the seat. An air pressure shall be applied on the underside of the valve seat with the valve seating surface in a horizontal plane and in closed position. The other side of the valve seat shall be filled with water at atmospheric pressure. The air test pressure shall be as specified in VSS. The duration of the test shall be not less than 5 min or as specified in VSS. The maximum permissible leakage shall be as specified in VSS. This test shall be conducted subsequent to hydrostatic test.

7.7 Test of Valve Actuators

7.7.1 Type test shall be carried out, wherever specified in the specification sheet.

7.7.2 Each actuator must be performance tested and individual test certificates shall be supplied. The test equipment shall simulate a typical valve load and the following parameters shall be recorded.

(i) Current at maximum torque setting
(ii) Torque at maximum torque setting
(iii) Test voltage and frequency
(iv) Flash test voltage

(v) Actuator output speed or operating time

7.7.3 Actuator shall be tested for capability to start at 80% of rated voltage with full load.

7.7.4 High voltage test on motor and control wiring at 1500V for 1 minute.

7.7.5 In addition, the test certificate shall record details of specification such as gear ratios for both manual and automatic drive, closing direction, wiring diagram code number etc.

7.8 Test on Assembled Valve and Actuator Functional Test

7.8.1 All manual valves as well as power operated valves shall be subjected to functional qualification test at the design service pressure as stated on the individual valve specification sheet.

7.8.2 The complete valve assembly along with the actuator shall be operated with disc differential pressure from fully closed to fully opened and vice versa. Checks shall be included in QAP for free movement of valve door, open/ close timings, operation of limit/ torque switches and indicator.

7.8.3 Current drawn by the motor shall be measured during opening and closing. Functioning of limit switches shall be checked.

7.9 All valves hydrostatically tested shall be completely drained prior to despatch.

7.10 For all valves supplier shall submit:

(a) Pressure test certificates.
(b) Foundry/Forge shop material certificates for castings/forgings properly corelating.
(c) Compliance certificates that all materials of construction for the various components are in conformity with the specification.
(d) Test certification of actuator and assembled valve actuator.
(e) Certificates etc. shall be submitted to the BHEL's/ Customer's representative during final inspection. The valves shall not be shipped before proper shipping release note is obtained from the BHEL/ Customer. Examination and inspection by BHEL/ Customer shall not relieve the supplier of his contractual responsibility to furnish valves in compliance with specification and meeting specified guarantees.

8 PERFORMANCE GUARANTEE

The Manufacturer shall guarantee the material & workmanship of all components as well as operation of equipment as per specification sheet & approved QAP. The valves and all accessories shall be designed so as to guarantee an easy disassembling and maintenance.

9 SCOPE OF SUPPLY

Butterfly Valves shall be supplied with all accessories required for successful operation after installation at site. Any requirement, if not specifically mentioned in this specification, for ensuring completeness of supply & successful installation and valve operation at site shall be considered by the bidder & included in the offer. BF Valve price shall be quoted for complete scope (i.e., BFV ready for use condition) which shall comprise of items mentioned below:

9.1 List of items in the scope of supply:

(i) Complete Assembly of Butterfly Valve
(ii) BF valve Operator
(iii) Both side companion Flanges along-with associated Gasket & Hardware
(iv) Complete foundation items (e.g., foundation plate, associated fasteners, etc.) required for erection of Butterfly Valve.
(v) Commissioning and Mandatory spares (Details below)

9.2 Spares details

The Supplier shall provide each of the following components as spare parts for each set of identical valves.

9.2.1 Commissioning Spares

Commissioning spare includes following items:

Sr. No.	Item Description	Unit of Measure	Qty Required
1.	Disc seal	set	1 set for each valve
2.	‘O’ ring seals	set	1 set for each valve

9.2.2 Mandatory Spares

Mandatory spare includes following items:

Sr. No.	Item Description	Unit of Measure	Qty Required
1.	Door / Disc Seal	set	2 set for each valve
2.	Gland Packing	set	2 set for each valve
3.	‘O’ ring seals	set	2 set for each valve
4.	Flange Gasket	set	2 set for each valve
5.	Shearing pins and dowel pins	set	2 set for each valve
6.	Disc seal clamping ring	set	1 Set for each set of identical valves.
7.	Body seat ring (replaceable type)	set	1 Set for each set of identical valves.

8.	Shaft Bearing	Set	1 Set for each set of identical valves.
9.	Seat and seal clamping fastener	Set	20 % of Total Quantity

(1 set means quantity required for one valve)

10 SPECIAL CLEANING, PROTECTION AND PAINTING

All valves shall be free of mill scale. The inside of all the valves shall be free of sand, dirt and other foreign matter. All openings shall be adequately sealed.

A sack containing silica gel desiccant shall be firmly attached to the inner surface on the cover of one end of each valve.

The outside surface of the valves shall be given two shop coat of red lead primer or approved equivalent primer as required to prevent corrosion, after release has been given for painting and before dispatch. Final painting shall be carried out as per painting requirements specified in valve specification sheet.

11 IDENTIFICATION & MARKING

The valve body and attached plate shall be marked with the information called for in MSS-SP.

The following data concerning the valve shall be shown on the valve or the valve name plate.

1) Manufacturer's name, year of manufacture.
2) Valve rating, pressure and temperature.
3) Body size
4) Body material
5) Type
6) Preferred direction of Flow

The following data concerning the actuator shall be shown. The actuator name plate may be combined with the valve name plate.

1) Manufacturer's name, year of manufacture.
2) Model No
3) Serial number
4) Size
5) Details of electric motors for electric actuators.

In addition, each valve shall be attached with an identification metal tag with corrosion resistant wire. The identification tag shall show valve identification as per the individual specification sheets / valve list /Tender Document. The same number shall appear on any loose accessory component packaged and shipped with the valve.

12 PACKAGING AND DISPATCH:

12.1 All **valves** shall be prepared for shipment in accordance with the instructions stated below:

(a) After testing, each valve shall be drained, cleaned, dried completely and suitably protected in sturdy wooden box so as to avoid damage during transit and storage.
(b) All exterior surfaces shall be painted with suitable paint in accordance with painting requirements specified in specification.
(c) The valves shall be so packed and protected as not to suffer corrosion, deterioration or damage of any sort during shipment to end storage at the project.
(d) All components shall be packed, suitably boxed and protected from damage in transit to the site in India. Equipment shall be prepared for a transit period exceeding two months.
(e) The construction and lining of the boxes shall provide protection for their contents. The packaging shall include adequate cushioning, blocking, bracing, skidding, hoisting and the tie down provisions. The packaging shall be subjected to the approval of BHEL/ Customer.

12.2 Companion Flanges shall be drilled as per the specified standard and all exposed surfaces shall be protected by fitting 20 mm thick plywood blank flange held in place with 4 bolts and sealed with a blank gasket of natural rubber or equivalent so that they are not damaged during transportation.

12.3 No shipment shall be done unless shipping release is issued by the purchaser in writing and for shipment.

13 DATA / DOCUMENTS TO BE SUBMITTED

13.1 Data / Documents to be submitted along with the bid

(a) Filled applicable Data sheets
(b) Catalogues
(c) Outline drawings for each type of valve and operator assembly, indicating various dimensions, part details and material of construction, details of ends, location of support etc. Clearance above or below the centre line of valve bodies to remove inner parts from valve bodies shall also be indicated.
(d) Typical sectional details for each type of valves, showing internal arrangement and parts list shall be submitted along with the bid.
(e) Torque & shaft sizing calculation.
(f) Curves showing valve opening flow coefficient (C_V) characteristic / pressure drop curves / K_v values and flow characteristics curves shall also be submitted.
(g) Valid POD test certificates as per standard of offered butterfly valves for offered seat design & MOC along with test reports consisting of test procedure and test set up. In case, the same is not available, Bidder to confirm to carry out POD during contract stage as per approved proof of design procedure.
(h) List of sub-vendors' for BOIs includes CS/SS Plates, Castings & Forgings, Hardware, Rubber Seals, Bearing/Bush etc. including Actuator supplier(s).
(i) Deviation, if any.

(j) Sealed & Signed copy of this specification and enclosed Annexures & Schedules as acceptance to technical requirements.

13.2 Documents to Be Submitted After Placement of Order / At Final Stage / Inspection History Document

(a) Following **Documents and procedure** shall be submitted for approval by the **NPCIL**.

(i) General Arrangement (GA) drawings showing valve construction, MOC of parts (BOM), counter flanges, dimensions, O/C timing, design & testing requirement, other technical details and Sectional details for each type of valves, showing internal arrangement.
(ii) Painting specification / procedure inline with NPCIL Painting specification.
(iii) Shaft diameter selection, shaft to disc connection pins sizing, operator sizing and opening, closing torque calculation in line with AWWA-C-504
(iv) Actuator datasheet, installation instruction and wiring diagram.
(v) Curves showing valve opening flow coefficient (C_V) characteristic / pressure drop curves / K_V values and flow characteristics curves.
(vi) Valve specification datasheet.
(vii) Quality assurance plan (QAP)
(viii) NDT procedures
(ix) Manufacturing sequence plan
(x) Performance Test Procedure
(xi) Proof of design procedure for butterfly valves
(xii) Type test Procedure for Valve Actuator
(xiii) Hydro body and seat test procedure
(xiv) Air leak body and seat test procedure
(xv) Welding and weld repair procedure, where applicable.
(xvi) Heat treatment procedure, where applicable.
(xvii) Packing Procedures

Documents other than above if required by customer (end user) shall be submitted by vendor as and when asked for.

(b) Material Test Certificates, Shop Test Reports & Certificates along with other inspection reports as per approved QAP shall be furnished to BHEL before dispatch.

(c) Bound History dockets - five sets each comprising the following documents.

The supplier shall be required to submit the following documents along with despatch of equipment

(i) P.O. and Sub-Order copies.
(ii) Approved as built drawings.
(iii) Approved QAP's
(iv) Approved Procedures.
(v) Material test certificates.
(vi) NDT Reports.

(vii) Hydrostatic Test Certificates.
(viii) Performance Test Procedure and Performance Test Reports with curves / other test reports.
(ix) Dimensional Reports.
(x) Shipping release copies.
(xi) All Design Concession reports if any.
(xii) Guarantee and Compliance Certificate.

(d) Five hard and soft copies / sets Operation and Maintenance Manuals covering Preventive maintenance requirements and procedures.
(e) Five hard and soft copies of Reproducibles for each of the drawings, and drawings on magnetic media preferably on CD.

14 QUALITY ASSURANCE PLAN

The QA plan of the work clearly showing the Customer hold points, review points of tenderer has to be submitted along with the offer. Quality assurance plan for the work covered by this specification shall be as per the Customer approved QAP.

15 DEVIATION

Deviation from specification requirement (if any), needs to be clearly mentioned & listed in Separate sheet along with techno commercial offer. It is BHEL/Customer prerogative to accept such deviation during offer evaluation.

Annexure - A

GENERAL REQUIREMENT:

Parameter	Specification
Valve Type	Butterfly Valve with Flanged End
Size	Refer Annexure-B
Pressure Rating	150 LBS
Valve Type	Cast Valve, Valve Fabricated from Plate are not acceptable.
Design Standards	AWWA C504
Testing Standards	AWWA C504
Flanged Ends Standards	AWWA C-207 CLASS-D

DESIGN REQUIREMENT:

Description	Requirement
Body	Short Body Flanged Ends, Casted Double Eccentric Offset Disc Design with Low Torque Requirement, Over Travel Limit Stoppers
Disc/Door	Single cast piece
Stem	Blow out Proof Design (Refer Note 5&6)
Stem Seal Type	"O" Ring/"U" Cup Seal (Material: Viton)
Bearing Material	Phosphor Bronze/Other material having self-lubricating properties
Disc Seal Type	Musical Note Type (Note-8)
Seal Clamping Ring	Single piece
Body Seat Ring	Single piece
Handwheel	Yes (Material: ASTM A216 WCB/CS)
End Connections	Flat face, serrated finish, as per AWWA C207 Class D. (Refer Note-13)

MATERIAL OF CONSTRUCTION:

Component	Material Specification
Body	Refer Annexure-B
Disc/Door	Refer Annexure-B
Stem	ASTM A479 TP 410
Bearing Material	Phosphor Bronze/Other material having self-lubricating properties
Body Seat Ring	ASTM A479 TP 316
Seal Clamping Ring	ASTM A479 TP 316
Seal	EPDM, Shore Hardness 65 ±5.
Internal Fastener	Bolts: ASTM 193 GR B8M ASTM 194 GR 8M

Internal hardware	Pin/Locknuts/etc shall made of SS316
External Hardware	Bolts: SA 193 GR B7 (Phosphated) & Nuts: SA 194 GR 2H (Phosphated)

ELECTRICAL ACTUATOR REQUIREMENT:

Parameter	Data
Power Supply	415V AC, 3 Phase, 50 Hz
Enclosure Type	IP-68
Insulation Class	CL-F
Integral Starter	Required
Type of Setting	Non-Intrusive
Interface with control System	Profibus DP (with redundancy)
Torque/Limit Measurement Transmitter	Required
Position Measurement Transmitter	Required
LCD Display Integral to Actuator Body	Required
Step down control transformer	Required
Local/ Remote selector switch Lockable	Required
Handwheel	Required; to disengage automatically during motor operation.
Earth terminal	Required
Opening/Closing Time	30-60 Sec
Overload protection	Required
Space Heater	Required
Reverse DOL Scheme	Inbuilt/ Integral to Actuator
Motor Duty	On-Off (S2)
Torque Rating	(Refer Note 20)

OPERATOR CONSTRUCTION:

Parameter	Specification
Gear Box Ratio	As per Manufacturer
Body/Casing Material	Material: Gray cast iron/ Malleable iron
Gears	Material: Stainless Steel/ Alloy Steel
Shaft	Material: ASTM A 479 TP 410
Seal/ "O" Ring	Material: Viton
Gearbox Fill	Material: As per Manufacturer
Bushes	Material: As per Manufacturer

SERVICE CONDITIONS:

Parameter	Value
Fluid	Water
Design Pressure [kg/cm²(g)]	Refer Annexure-B
Maximum Pressure	Manufacturer to specify
Max Temperature	50°C
Flow (max)	Refer Annexure-B
Flow (Normal)	Refer Annexure-B
Specific Gravity @ 25°C	0.997
Viscosity @ 25°C	0.89 cP
Δ P (kg/cm²)	Manufacturer to specify
C_v	Manufacturer to specify
Valve Characteristics	Manufacturer to specify
Disc Differential Pressure [kg/cm² (g)]	Same as Design Pressure of The System.

TESTING REQUIREMENTS*:

Test Type	Test Pressure [kg/cm²(g)]	Duration (min)	Acceptance Criteria
Hydrostatic Body Test	As per Valve Class	10	No Visible Leakage
Hydrostatic Seat/Disc Leak Test (Both Direction)	As per Valve Class	5	Drop Tight
Air Leak Seat Test	As per Valve Class	5	Bubble Tight

*NPCIL to witness test as per Approved QAP

1. TYPE TEST – VALVE

POD Test	Standards
Disc Strength, Cycle Test, Torque Test	AWWA C504

2. TYPE TEST – ELECTRICAL ACTUATOR

Type Test on Electrical Actuator (Refer Note-27)	On One Motor	NPCIL to witness one Valve & 100% by BHEL/BHEL TPIA
Routine Test on Electrical Actuator (Refer Note-27)	100 %	

3. OTHERS TESTS

All Raw Material	Physical and Chemical T.C. from Manufacturer with Heat No. Correlation
Shaft Dimension Test	UT with 2 mm preferential Flat Bottom Back Hole
Dimensional Checks	100% by Package contractor & Sample Check by Purchaser

NOTES:

1. Manufacturer shall submit QAP and obtain NPCIL approval before manufacturing.
2. Shaft diameter selection, shaft to disc connection pins sizing, operator sizing and opening, closing torque calculation to be submitted in line with AWWA-C-504 for NPCIL verification
3. Bi-directional bubble tight seal is required.
4. Double eccentric valves with low torque requirement.
5. Stem should not come in contact with flowing fluid (i.e. It should remain dry).
6. High strength stub shaft shall be provided with minimum 1.5 times dia. Penetration into disc hubs with close tolerance fit and secured with adequate number and capacity lock pins.
7. Valve face to face dimensions shall be as per AWWA - C-504-short.
8. Sealing Seat (EPDM Material) shall be either on body or on disc and the shape shall be musical note type giving reliable leak tightness. Valves sealing seat shall be in-situ replaceable type.
9. Integral position indicator on the stem and top mounting flanges for positive disc position identification shall be provided.
10. Integral cast adjustable travel stop is to be provided on valve body.
11. Valve shaft shall be provided with either one or two thrust bearings to hold the valve disc in secure position. Thrust calculation considering **Note-15** shall be submitted by bidders.
12. Only Cast valves are acceptable. Valves fabricated from plates are not acceptable.
13. Valve ends to suit AWWA C-207, class-D for sizes beyond 300 NB
14. Valve shall be suitable for both “on-off” as well as “throttling “applications under maximum differential pressure.
15. Valves should be able to perform in vertical and horizontal orientation, upstream or downstream of elbows and pipe reducers.
16. Surface preparation as per SA 2.5, External and internal painting shall be done as per NPCIL specification **PC-E-615 in line with Clause 6.6**, which shall be submitted for NPCIL approval.
17. External painting of cast iron & carbon steel surfaces shall be carried out as per package specification.
18. The reversing starter, control transformer and local control shall be integral with the valve actuator suitably housed to prevent breathing and condensation.
19. The starter shall be suitable for 60 starts per hour and rating appropriate to the motor size.
20. Maximum valve torque requirement shall be worked out considering bi-directional sealing, disc differential pressure equivalent to valve rating pressure and hydraulic forces on disc

due to change of direction of flow within one Dia length upstream or downstream. Vendor shall submit valve actuator sizing calculations for approval

21. Actuator gearing shall be totally enclosed & lubricated.
22. Electrical actuator shall be capable of operating the valve at 80 % of the supply voltage, frequency variation± 5 % and combined voltage and frequency variation± 10% allowed.
23. Two earthing terminals of M6 shall be provided on electric actuator body.
24. Electric actuator internal power wiring shall be 1.1 kV grade and control wiring shall be 660 V grade.
25. Electric motor shall be squirrel cages 3 phase induction motor, totally enclosed non-ventilated type.
26. Refer tender specification section **C-2-3-10** and **C-2-4-38** for electrical valve actuator.
27. Type test & routine test on electrical valve actuators shall be carried out as per EN-15714 part II & IS 9334 respectively.

ANNEXURE-B

Sl. No	Valve TAG Nos.	Line no.	Service Description	Size (NB)	Opern.	Design Press. Kg/cm²(g)	Design Temp. (°C)	Normal Flow (M^3/Hr)	Maximum Flow (M^3/Hr)	Valve Body & Disc Material	Pipe OD (mm)	Pipe Thk. (mm)	QTY. (No)	Remarks
1	$-7121-EV-1005	1800-CW-1-7121-1005	CONDENSER WB-1 INLET	1800	ELECTRICALLY OPERATED	6.5	50	Later	Later	IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
2	$-7121-EV-1101	1800-CW-1-7121-1101	CONDENSER WB-1 OUTLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
3	$-7121-EV-1006	1800-CW-1-7121-1006	CONDENSER WB-2 INLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
4	$-7121-EV-1102	1800-CW-1-7121-1102	CONDENSER WB-2 OUTLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
5	$-7121-EV-1007	1800-CW-1-7121-1007	CONDENSER WB-3 INLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
6	$-7121-EV-1103	1800-CW-1-7121-1103	CONDENSER WB-3 OUTLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
7	$-7121-EV-1008	1800-CW-1-7121-1008	CONDENSER WB-4 INLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
8	$-7121-EV-1104	1800-CW-1-7121-1104	CONDENSER WB-4 OUTLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
9	$-7121-EV-1009	1800-CW-1-7121-1009	CONDENSER WB-5 INLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
10	$-7121-EV-1105	1800-CW-1-7121-1105	CONDENSER WB-5 OUTLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
11	$-7121-EV-1010	1800-CW-1-7121-1010	CONDENSER WB-6 INLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
12	$-7121-EV-1106	1800-CW-1-7121-1106	CONDENSER WB-6 OUTLET	1800	ELECTRICALLY OPERATED	6.5	50			IS 1865 GR 500/7 DUCTILE IRON (SG)	1829	14	2	1 for each Unit
13	$-7315-EV-8608	500-ACW-1-7135-8675	GENERATOR HYDROGEN & EXCITER AIR COOLER OUTLET	500	ELECTRICALLY OPERATED	10	55			ASTM A216 CCS (WCB)	508	9.5	2	1 for each Unit

$ - For Unit Numbers, Specification of respective Project Shall Be Referred to Identify Unit Numbers.

ANNEXURE - C

DATA SHEET FOR POWER OPERATED VALVES

(To be filled and submitted by Vendor for each type/size of valve along with the bid)

1.0 Technical Particulars

1.1 All the data as requested in Valve Specification sheet

1.2 General (Indicative valve tag nos as per the specification sheet)

(a) Tag number
(b) Manufacturer
(c) Model No
(d) Whether double flanged (Yes / No)
(e) Size of the valve (mm NB)
(f) Number offered
(g) Installation (Horizontal / Vertical Shaft)

1.3 Equipment Performance

(a) Maximum disc differential pressure (Kg/cm^2 g) :
(a) Maximum differential back pressure allowable for valve operation (Kg/cm2 g) :
(b) Maximum allowable flow (m^3/hr) :
(c) Maximum allowable fluid velocity through valve (M/sc.) :
(d) Pressure drop across the valve at design flow (Kg/cm^2 g) when valve is fully open :
(e) Angle of travel from wide open to shut-off condition (applicable for Gate Valve only) :
(f) Total lift from full open to shut-off condition (applicable for Gate Valves only) :
(g) Design pressure (Kg/cm^2 g) :
(h) Design temperature Deg. C :

1.4 Design and Construction

(b) Valve design standard :
(c) Design pressure class :
(d) Maximum torque required at the disc. shaft for operation (Kg. M) (Including seating and unseating) :

1.5 Valve Body and Disc

(a) Body construction : Cast
(b) Pressure class :

(c) Thickness of disc. :
(d) Disc. construction : Cast
(e) Flange drilling standard for flanged valve :

1.6 Valve Seat

(a) Material :
(b) Location :
(c) Seat thickness (mm) and radial width (mm) : On Body / On Disc
(d) Whether of replaceable design : Yes / No
(e) Whether reinforcement provided (applicable for resilient material) : Yes / No
(f) Number of retaining ring segments. :

1.7 Valve Shaft

(a) Shaft attachment piece : Stubbed / Single
(b) Shaft diameter (mm) :

1.8 Shaft Bearing

(a) Type and make :
(b) Location :
(c) Numbers provided :
(d) Catalogue no. :
(e) Design life at normal operating conditions (hrs.):
(f) Whether self lubricating : Yes / No

1.9 Thrust Bearing

(a) Type and make :
(b) Catalogue no. :
(c) Location :
(d) Numbers provided :
(e) Design axial thrust (kgf) :
(f) Design life at normal operating condition :

1.10 Shaft Seal

(a) Type : "O" ring/gland packing
(b) Location :
(g) Seal replacement possible with dismantling the valve : Yes / No

1.11 Material of Construction

(a) Valve body :
(b) Valve disc. :
(c) Valve seat ring :
(d) Valve shaft :
(e) Shaft bearings :
(f) Thrust bearings :
(g) Shaft seals / stuffing box packing :

(h) Gears :
(i) Extensions spindle, if any :
(j) Clamping ring :
(k) Handwheel / chain wheel :
(l) Internal fasteners (Pins, screws etc.) :
(m) External fasteners :
(n) Floor stand, if any :
(o) Seal :
(p) Gear casing :

1.12 Inspection and Testing

1.12.1 Material test :

1.12.2 Hydrostatic test:
(a) Pressure (Kg/cm sq. g) :
(b) Duration (Mins.) :

1.12.3 Dis. Strength test
(a) Disc. strength test pressure (Kg/cm sq. g) :
(b) Duration (Mins.) :

1.12.4 Air Leakage Test :
(a) Pressure (Kg/cm sq. g) :
(b) Duration (Mins.) :

1.12.5 Seat Test
(a) Pressure (Kg/cm sq. g) :
(b) Duration (Mins.) :

1.13 Valve Seal

(a) Whether seal is mounted on disc or body :
(b) Thickness and radial width of seal (mm) :
(c) Type of reinforcement or inserts provided in rubber seal :
(d) Replaceable design :

1.14 Clamps & Retaining Rings etc., for Rubber Seal

(a) Type :
(b) Type of Construction :
(c) Replaceable design :

1.15 Probabilistic Safety Analysis Input Data: Following data to be submitted

(a) Mean time between failures (MTBF) :
(b) Test Frequency :
(c) Impact of ageing on performance :
(d) No. of cycles of operation in life time:

1.16 Weight Data

(a) Weight of the valve assembly complete with :

(b) gearing, motor etc. (Kgs.)
(c) Weight of the largest piece to be handled (Kgs) :

2.0 Drawing and Curves

The bidder shall submit the following drawings with the proposal.

2.1 Outline drawings for each type of valve and operator assembly, indicating various dimensions, part details and material of construction, details of ends, location of support etc. Clearance above or below the centre line of valve bodies to remove inner parts from valve bodies shall also be indicated.

2.2 Typical sectional details for each type of valves, showing internal arrangement and parts list.

2.3 Curves showing valve opening flow coefficient (C_v) characteristic.

3.0 Information

The following information shall be submitted with the proposal.

3.1 Brief technical description of the equipment offered.

3.2 Previous experience in manufacturing similar equipment, examples of successfully operating equipment of the type and size similar to that offered.

4.0 Proof of Ability

The tenderer shall submit a brief list of work executed by him to standards and tolerances as specified in Tender Document.

5.0 Manufacturing and Delivery Schedule

Time in weeks from the Date of Issue of Purchase Order

5.1 Submission of drawings and documents for approval.
5.2 Start manufacture.
5.3 Complete manufacture.
5.4 Testing at manufacturer's works
5.5 Complete shipment.

6.0 Guarantee period offered Months

ANNEXURE - D

DATA SHEET FOR ELECTRIC ACTUATORS

(To be filled and submitted by Vendor for each type/size of valve along with the bid)

1.0 General

(a) Make :
(b) Type / Model :
(c) Rating :

2.0 Torque Rating

(a) Motor rating :
(b) Basic actuator rating :
(c) Final stage output :

3.0 Actuator output r.p.m :

4.0 Maximum thrust and direction :

5.0 Base plate details :

6.0 Motor to valve stem gear ratio :

7.0 Handwheel to valve stem gear ratio :

8.0 Handwheel

(a) Handwheel diameter :
(b) Handwheel material :
(c) Mechanical advantage :

9.0 Limit Switches

(a) Nos. provided :
(b) Type :
(c) Manufacturer :
(d) Rating :
(e) Range of setting :
(f) Location :

10.0 Torque Switch

(a) Nos. provided :
(b) Type :
(c) Manufacturer :
(d) Rating :
(e) Range of setting :
(f) Location :

11.0 Details of local position indicator

12.0 Speed

(a) Time to open fully closed valve :
(b) Time to close fully open valve :

13.0 Gearing

(a) Type of reduction & reduction ratio of gear box :
(b) Lubrication of gearing :
(c) Force required for operation :
(d) Mechanical stop provided or not :
(e) Size of handwheel :
(f) Material of gears :

14.0 Is the unit capable of being reversed while the drive is traveling at full speed?

15.0 Weight

(a) Weight of actuator :

16.0 Is the terminal enclosure capable of withstanding one second short circuit test?

2.3.10.1 All requirements as covered in section C-2-4 of this specification.

2.3.10.2 Specification for electric actuators for On/Off duty:

2.3.10.2.1 General

The actuators shall be suitable for use on a nominal 415 volt 3-phase 50 Hz power supply and are to incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.

In order to maintain the integrity of the enclosure, setting of the torque levels, position limits and configuration of the indication contacts etc. shall be carried out preferably without the removal of any actuator covers and without mains power over an Infra-red or Bluetooth® wireless interface. Commissioning tools shall be provided with the actuators and must meet the enclosure protection and certification levels of the actuators. Commissioning tools shall not form an integral part of the actuator and must be removable for secure storage/authorized release. In addition, provision shall be made for the protection of configured actuator settings by a means independent of access to the commissioning tool.

2.3.10.2.2 Actuator sizing

The actuator shall be sized to guarantee valve closure at the specified differential pressure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. The operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise stated in the valve specification.

2.3.10.2.3 Environmental

Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from 0°C to 45°C, up to 90% relative humidity. Actuators for explosion-hazardous

applications shall in addition be certified Flameproof for Zones 1 and 2 (Divisions 1 and 2 Group gases).

2.3.10.2.4 Enclosure

Actuator shall have IP68 (NEMA-4) enclosure. There should be a dustproof seal between terminal compartment and the internal electrical elements of the actuator. The motor and all other internal electrical elements of the actuator shall be protected from ingress of moisture and dust when the terminal cover is removed for site for cabling. Enclosure must allow for temporary site storage without the need for electrical supply connection. All external fasteners shall be of stainless steel, however, the use of unprotected stainless steel fasteners (including grease lubricated) in aluminium alloy casings is not permitted.

2.3.10.2.5 Motor

The motor shall be an integral part of the actuator, designed specifically for valve actuator applications. It shall be a low inertia high torque design, The electric motor shall be Class F insulated, with a time rating of at least 15 minutes at 104°F(40°C) or twice the valve stroking time, whichever is the longer, at an average load of at least 33% of maximum valve torque. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gear case.

2.3.10.2.6 Motor protection

Protection shall be provided for the motor as follows:

(1) Stall - the motor shall be de-energized within 5 seconds in the event of a stall when attempting to unseat a jammed valve.
(2) Motor temperature shall be sensed by a thermostat, de-energizing the motor in case of overheating of motor, protecting it from permanent damage.
(3) Lost phase protection.
(4) Single phasing - lost phase protection

2.3.10.2.7 Gearing

The actuator gearing shall be totally enclosed in a oil-filled gear case suitable for operation at any angle. All drive gearing and components must

be of metal construction and incorporate a lost- motion hammer blow feature. For rising spindle valves the output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gear case for inspection or disassembled without releasing the stem thrust or taking the valve out of service.

2.3.10.2.8 Hand operation

A handwheel shall be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. The handwheel or selection lever shall not move on restoration of motor drive. Provision shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train. The handwheel drive must be mechanically independent of the motor drive and any handwheel gearing should be such as to permit emergency manual operation in a reasonable time with a manual force not exceeding 400N through stroke and 800N for seating/unseating of the valve. Clockwise operation of the handwheel shall give closing movement of the valve unless otherwise stated in the valve specification.

2.3.10.2.9 Drive bushing

The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bush shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base should be of the sealed for life type.

2.3.10.2.10 Torque and turns limitation

Torque and turns limitation to be adjustable as follows:

(1) Position setting range for multi-turn actuator: 2.5 to 8,000 turns, with resolution to 7.5 deg. of actuator output.
(2) Position setting range for direct drive part turn actuators: 90° +/-10°, with resolution to 0.1 deg. of actuator output.
(3) Torque setting: 40% to 100% rated torque.

"Latching" to be provided for the torque sensing system to inhibit torque off during unseating or during starting in mid-travel against high inertia loads. The electrical circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.

2.3.10.2.11 Remote valve position/actuator status indication

Four contacts shall be provided which can be selected to indicate any position of the valve. Provision shall be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated.

The contacts shall be rated at 5A, 250V AC, 30V DC.

Each contact shall be independently configurable using supplied commissioning tool to signal one of the following:

(1) Valve opening, closing or moving
(2) Thermostat tripped, lost phase
(3) Motor tripped on torque in mid travel, motor stalled
(4) Remote selected
(5) Actuator being operated by handwheel

Provision shall be made in the design for an additional eight contacts having the same functionality.

A configurable monitor relay shall be provided as standard, which can be used to indicate either Availability or Fault. The relay should be a spring return type with a Normally Open / Normally Closed contact pre-wired to the terminal block.

The Monitor (availability or fault) relay, being energized from the control transformer will de-energize under any one or more the following conditions:

Available Mode	**Fault Mode**
Loss of main or customer 24V DC power	Loss of main or customer 24V DC power supply
Motor thermostat tripped	Motor thermostat tripped

Actuator internal fault	Actuator internal fault
Actuator control selected to local or stop	No

Provision shall be made in the design for the addition of a contactless transmitter to give a 4-20mA analogue signal corresponding to valve travel and / or torque for remote indication when required. The transmitter will auto range to the set limits

2.3.10.2.12 Local position indication

The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With mains power connected, the display shall be backlit to enhance contrast at all ambient light levels and shall be legible from a distance of at least 5m (16ft).

Green, red, and yellow LEDs corresponding to open, closed and intermediate valve positions shall be included on the actuator display when power is switched on. End of travel indication colours shall be reversible. The yellow LED should also be fully programmable for on/off, blinker and fault indication.

The digital display shall be maintained and updated during handwheel operation when mains power to the actuator is isolated. The actuator display shall include a fully configurable dot-matrix display element to display operational, alarm, configuration and graphical datalogger information. The text display shall be in English. The display shall incorporate valve, actuator and control status indication.

Datalogger graphical displays should as a minimum be able to display log and trend graphs on the local LCD for the following:

- Torque versus Position
- Number of Starts versus Position
- Number of starts per hour
- Dwell Time
- Average temperature

Provision shall be made for the addition of an optional environmental cover to protect the display from high levels of UV radiation or abrasive materials.

The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.

2.3.10.2.13 Integral starter and transformer

The reversing starter, control transformer, electrical protection relays and local controls shall be integral with the valve actuator suitably housed to prevent breathing and condensation.
The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. However for very high torque actuators number of starts per hour can be relaxed subjected to prior approval of NPCIL.
The controls supply transformer shall have the necessary tapings and be adequately rated to provide power for the following functions:

- Energization of the contactor coils.
- Supply for all the internal electrical/electronic circuits.

2.3.10.2.14 Integral local control and control mode selector

The actuator shall incorporate local controls for Open, Close and Stop and a Local/Stop/Remote mode selector switch lockable in any one of the following three positions: local control only, stop (no electrical operation), remote control plus local stop only. It shall be possible to select maintained or non-maintained local control.

There should not be any penetration in actuator cover where these knobs are installed. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

Provision shall be made to orientate the local controls through increments of 90^{o}.

2.3.10.2.15 Control facilities

The necessary wiring and terminals shall be provided in the actuator for the following control functions:

(1) Open and close external interlocks to inhibit local and remote valve opening and/or closing control. Provision shall be made to configure the interlocks to be active in remote control only.

(2) Remote controls fed from an internal 24V DC supply or from an external supply between 24V ± 20% DC, to be suitable for anyone or more of the following methods of control:
   (a) Open, Close and Stop control.
   (b) Open and Close maintained or "push to run" (inching) control.
   (c) Overriding Emergency Shut-down to Close (or Open) valve from a normally closed or open contact.
   (d) Two-wire control, energize to close (or open), de-energize to open (or close).

It shall be possible to reverse valve travel without the necessity of giving a stop command. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energization of the contactor coils.

The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lighting impulses of up to 2kV.

Additionally provision shall be made for a separate 'drive enable' input if required to prevent any unwanted electrical operation.

Provision shall be made for operation by utilizing Profibus network systems and by hardwired control.
Alternatively, actuators can be connected to master station that is connected to DCS. For detailed requirement specification of master control station please refer section C-2-4 of this tender document.

2.3.10.2.16 Monitoring facilities

Facilities shall be provided for monitoring actuator operation as follows: Actuator text display indication of the following status/alarms:

(1) Closed Limit, open limit, moving open, moving closed, stopped
(2) Torque trip closing, torque trip opening, stalled
(3) ESD active, interlock active

(4) Thermostat trip, phase lost, 24V supply lost, Local control failure
(5) Configuration error, Position sensor failure, Torque sensor failure
(6) Battery low, power loss inhibit

Integral data-logger to record and store the following operational data:

(1) Opening last /average torque against position
(2) Closing last /average torque against position
(3) It should be possible to record torque characteristics at different times. The comparison of data sets allows assessment of any change in valve characteristics.
(4) Opening motor starts against position
(5) Closing motor starts against position
(6) Total open/closed operations
(7) Maximum recorded opening and closing torque values
(8) Event recorder logging operational conditions (valve, control and actuator)

The data logger shall record relevant time and date information for stored data.

The actuator shall include a diagnostic module, which will store and enable download of historical actuator operation and torque data to permit analysis of actuator and valve in- service performance. Data download shall be carried out without removing any covers and all shall be available locally to the actuator or remotely via telecom data transfer. Diagnostic and configuration software shall be made for user DCS or diagnostics station.

Facilities shall be provided for monitoring actuator availability as follows:- Monitor (availability) relay, having one changeover contact, the relay being energized from the control transformer only when the Local/Off/Remote selector is in the Remote position to indicate that the actuator is available for remote (control room) operation.

It shall be possible to provide indication of Thermostat trip and Remote selected as discrete signals.

2.3.10.2.17 Wiring and terminals

Internal wiring shall be tropical grade PVC insulated stranded copper conductor of appropriate size for the control and power. Each wire shall be clearly identified at each end.

The terminals shall be embedded in a terminal block of high tracking resistance compound. The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal and shall be provided with a provision of connection of minimum 3 nos. of Purchaser's external cable termination.

All wiring supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:

(1) Serial number
(2) External voltage values
(3) Wiring diagram number
(4) Terminal layout

This must be suitable for the contractor to inscribe cable core identification alongside terminal numbers.

2.3.10.2.18 Start-up kit

Each actuator shall be supplied with a start-up kit comprising installation instruction manual, electrical wiring diagram and cover seals to make good any site losses during the commissioning period. In addition, sufficient actuator commissioning tools shall be supplied to enable actuator set up and adjustment during valve/actuator testing and site installation commissioning.

2.3.10.2.19 Performance test certificate

Each actuator must be performance tested and individual test certificates shall be supplied free of charge. The test equipment should simulate a typical valve load, and the following parameters should be recorded.

(1) Current at maximum torque setting
(2) Torque at max. torque setting
(3) Flash test voltage
(4) Actuator output speed or operating time.

In addition, the test certificate should record details of specification such as gear ratios for both manual and automatic and second stage gearing if provided, drive closing direction, wiring diagram number.

2.3.10.2.20 Applicable standards: EN 15714-2, IEC 61158, IEC 61784, EN/ISO 5210.

Specification for smart electric valve actuator remote control system (Master Control Station)

GENERAL:

The data monitoring and control system shall consist of a master station and field units. The master station shall perform the tasks of bus master, data collector, data concentrator, operator interface, protocol converter and be a slave to a host system (DCS, PLC, RTU or computer).

The system shall be capable of operating with up to 240 field units on a 2 wire screened twisted pair data highway of length up to 10 kilometres without repeaters or other additional devices.

The cable shall be connected from the master station to each field unit in turn and back to the master station (ring topology).

The master station shall provide serial data communication with a host system such as a Distributed Control System, PLC, RTU or computer via data ports using either Modbus RTU or Modbus TCP protocol.

The master station and field units shall be protected against lightning by the provision of transient suppressor devices on all 2 wire connection ports rated at 1.5 kV for 1 millisecond. Opto-isolation shall be used within the field units and master station for enhanced noise protection.

MASTER STATION:

The master station shall be of microprocessor type, suitable either for panel or 19” rack mounting.

All signals from the master station to the field units shall be suitable for transmission over a 2 wire twisted pair cable with overall screen and shall use a current loop serial data communication.

Alternatively, fieldbus (Profibus) communication can be made between Host and Master Station.

This cable shall be connected from the master station to each field unit in turn and then back to the master station (ring topology).

It shall be suitable for the following operational conditions:

Operating temperature: -10 to 50 ^{O}C.

Storage temperature: -10 to 70 ^{O}C.
Relative Humidity: 5% to 95% non-condensing.
Power: 230V ± 20% Vac, 50 Hz ± 5%, 24V DC ± 20%

The master station shall include a graphical colour LCD display panel and operator control keypad to allow it to be used as an operator interface. Navigation between screens shall use icons backed with a text description. The display panel shall be capable of showing the status and Tag number of every connected field unit, actuator or other device associated with the field unit, the status of the master station, the system settings, the host protocol messages, the loop performance, any alarms present on the system and the status of any hot standby partner.

The keypad shall permit viewing and modification of all of the master station system data. It shall also allow the connected actuators or other devices to be monitored and operated. The parameters set in each field unit shall be visible and there shall be a mechanism for altering field unit settings (except address) either from the master station directly or via the host communications ports. The facility to test system performance and adjust the field communication speed shall be provided. It shall be possible to set the highest address number of connected field units to minimise scanning times.

A PIN, password or hardware key security system shall be included to prevent access to control and setting of parameters via the master station LCD and keypad. Control shall be able to be interlocked by inhibiting actuator commands from any host port. Direct access to the master station web pages via any of the Ethernet host communications ports shall be protected by a user name and password. The ability to allow only limited host IP addresses to access the master station via Modbus TCP will also be provided.

A real time clock shall be included for alarm event time/date marking and it shall be possible to synchronise this clock via an NTP (Network Time Protocol) server.

It shall be possible to capture and display on the LCD screen the last 5 messages sent to the master station and the replies from the master station, via the host communications ports. It shall be possible to view the loop status including a map of the connected field devices and their communications status.

Host Communications:

Host system communication shall be by RS232, RS485 or Ethernet. The host protocol shall be Modbus or Modbus TCP to minimise custom software and programming. There will be 4 host ports available, 2 serial ports, selectable as either RS232 or RS485 and 2 Ethernet ports.

The Baud rate for serial communications shall be adjustable from 2400 to 115200 with odd, even, always zero or no parity. There will be provision for an additional third Ethernet port (Service port) to be used for configuration and temporary connections. The Ethernet communications baud rate shall be 100MB or 10MB on all three ports.

The Ethernet ports will include a web server connection and embedded web pages and shall provide the ability to parameterise, control and monitor the connected actuators. The Ethernet port shall support up to 10 simultaneous users.

All communications ports shall be independent to ensure correct alarm handling to each of the connected hosts, or for use in redundant host communications.

Redundant Systems - Hot Standby:

The master station shall include a redundant 'hot standby' unit that will automatically assume control if the primary unit fails, this transfer of control shall be user transparent, bumpless and take less than 2 seconds. The status of the standby and primary units shall be available for review by the host system at all times. It shall be possible to change control from primary to standby unit either remotely (over the communication link) or locally by the keypad.

FIELD COMMUNICATIONS:

The 2 wire loop shall use a 20 mA current for data transmission with a maximum applied voltage of 17V. The current shall be modulated to enable messages to be transmitted. Full CRC and message framing checks must be included in the data protocol.

The system shall continuously cyclically poll each connected field unit and report any changes in status of the field unit or communication failure. On receipt of a command from the master station keypad or the host system such as a PLC the command shall take precedence over the data collection, polling shall cease and the command shall be immediately transferred to the field unit. Provision shall be included to ensure the field unit has received the command correctly.

Failure or loss of power to any one or more connected field units on the 2 wire cable shall not cause loss of control or communication with the remaining devices connected to the cable. On restoration of power to a field unit it shall be located and communicated with automatically.

The system shall tolerate a single open, short or ground fault in the 2 wire cable without losing the ability to communicate and control any field unit remaining connected. An alarm

shall be posted to indicate between which two field units the fault has occurred. Multiple faults shall result in the loss of communication with those field units which have become isolated and not the entire system. This cable security feature shall be inherent in the system and achieved using only a single cable without the need for duplicate or additional hardware.

Field Unit:

Field units shall be plug in cards, or easily added to existing valve actuators. They shall also be available in a variety of enclosures suitable for location in the field or control room environment.

Parameter Settings:

There shall be settings for the loop baud rate and unique address (up to 240) for each field unit. These settings shall be made non-intrusively without the need to remove covers or gain access directly to the field unit itself. Where general purpose field units are required it shall be possible to invert the reported input signal status.

Valve Actuator Field Units

When fitted to a suitable valve actuator the field unit shall require no additional power connection. The field unit shall form an integral part of the actuator assembly and it shall be an addition to the actuator control circuit and independent from that control circuit. It shall report the following signals to the master station:

Valve opening, Valve closing, Valve open, Valve closed, Valve stationary in mid position, Actuator fault, Field unit fault, Cable fault.

In addition it shall also report some or all of the following signals:

Continuous valve position

Monitor relay trip

Thermostat trip

Local Stop selected

Local Control selected

Valve Obstructed

Valve Jammed

Four additional remote digital input signals

Remote control functions shall be provided to permit the actuator to:

Open fully

Close fully

Stop at any time

Assume an intermediate position

Assume Emergency Shut Down position

Emergency Shut Down:

ESD shall be able to be set to cause the actuator to ESD Close, ESD Open, Stay Put. Receipt of an ESD signal shall override any existing, local or remote, open or close signal and shall override the motor thermostat. An additional hard-wired ESD facility shall still remain within the actuator control capability.

When forming an integral part of the actuator the field unit must be located in a separate compartment from the field terminals. This compartment shall be double 'O' ring sealed from the external environment. The whole enclosure shall be to IP68 (NEMA IV and NEMA VI). In hazardous area applications it shall be certified to a minimum of EExd IIB T4, or to the same certification as the actuator.

The actuator and field unit combination shall be suitable for an operating temperature range of -30 ^{o}C to +70 ^{o}C and +80 ^{o}C storage.

General Purpose Field Unit

General Purpose field units shall be similar to actuator field units with the same isolation and protection capabilities. They shall be capable of reporting the status of 8 digital and 2 analogue (for example 4-20 mA) inputs.

The field unit shall be capable of providing 4 digital outputs, each configurable for fleeting or maintained status and 1 analogue (0-5V) output. All I/O shall have discrete address capability.

When field mounted, the field unit enclosure shall be to IP68 (NEMA IV and NEMA VI). In hazardous area applications it shall be certified to a minimum of EExd IIB T4. The field unit must be located in a separate 'O' ring sealed compartment from the field terminals to preclude the ingress of moisture.

For control room location the field unit shall be 19 inch rack mounting and provided with a

suitable 19 inch rack. All connections to the unit shall be to the front.

The General Purpose field unit shall be suitable for an operating temperature range of -30oC to +70ºC and +80ºC storage.

TEST EQUIPMENT:

Hand held test equipment shall be provided to facilitate the testing of installed field units and the setting of field unit parameters. Field unit testers shall be able to emulate master station communication on the 2 wire loop terminals as well as evaluate status and diagnostic information.

Master station test equipment shall be in addition to the master station display and keypad. It shall connect to the RS232 host communication port and be capable of emulating a host system.

A Web based interface shall be available that is suitable for examining the system settings and determining all the field unit parameters. The master station settings shall be adjustable by use of this method and it will allow the recording to file and printing of records showing all system settings. This shall run on any internet enabled PC / Notebook.

SAMPLE QUALITY ASSURANCE PLAN FOR BUTTERFLY VALVES

S.NO.	COMPONENT AND OPERATION	CHARACTE-RISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORDS	AGENCY				REMARKS
									P	W	R	H	
I.	**INCOMING MATERIAL CONTROL**												
1.	**CASTINGS:**												
1.1	Body & Disc	Pouring	Major	Witness	100%	Approved Specification	As per approved specification	Inspection Report		2,1	1		
		Composition	Major	Chemical	One/Heat No.	Approved Specification	As per approved specification	Test Certificate		2	-	1	
		Mechanical Properties	Major	Mechanical tests	One/Heat No.	Approved Specification	As per approved specification	Test Certificate		2	-	1	
		NDE	Major	RTE	100%	Approved Procedure	As per approved procedure	Inspection Report		2	-	1	
1.2	**ROLLED PRODUCT:**												
	Shaft	Composition	Major	Chemical	One/Heat	Approved Specification	As per approved Specification	Test Certificate		2	-	1	
		Mechanical Properties	Major	Mechanical tests	One/Heat	Approved Specification	As per approved Specification	Test Certificate		2	-	1	
		NDE	Major	LPE/UTE	100%	Approved Procedure	As per approved procedure	Inspection Report		2	-	1	Hold for UTE only.
1.3	**PLATES :** Seat Ring	Composition	Major	Chemical Analysis	One/Heat No.	Approved Specification	As per approved Specification	Test Certificate		2	-	1	
2.	**BOUGHTOUT ITEMS**												
2.1	Seat	Hardness	Major	Measurement	One/lot	Approved Specification	As per approved Specification	Test Certificate		2	1		
2.2	Gear Box & Actuator	Type & Routine test	Major	Performance	100%	Approved Procedure	As per approved procedure	Inspection Report		2	1		

S.NO.	COMPONENT AND OPERATION	CHARACTE-RISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORDS	AGENCY				REMARKS
									P	W	R	H	
II.	**IN PROCESS CONTROL:**												
1.1	Body, Disc & Shaft	Dimensions	Major	Measurement	100%	Approved Drawing	As per approved Drawing	Inspection Report		2	1		
		NDE	Major	LPE	100%	Approved Procedure	As per approved procedure	NDE Records		2,1	1		
				UTE (on Stem)	100%	Approved Procedure	As per approved procedure	NDE Records		2	-	1	
		Pressure Resistance (for Body)	Critical	Hydro Test	100%	Approved Procedure	As per approved procedure	Test Report		2	-	1	
III.	**FINAL INSPECTION & CONTROL**												
1.	**ON FULLY ASSEMBLED VALVE :**												
		Disc Strength & Seat Leak tightness test	Critical	Hydro Test	100%	Approved Procedure	As per approved procedure	Test Report		2	-	1	
		Gland Leak tightness test	Critical	Pneumatic	One/Size	Approved Procedure	As per approved procedure	Test Report		2	-	1	
		Seat Leak Tightness Test	Critical	Leak Detection	One/Size	Approved Procedure	As per approved procedure	Test Report		2	-	1	
		Performance	Critical	Smooth Open-Close Operation	100%	Approved Procedure	As per approved procedure	Test Report		2	-	1	

S.NO.	COMPONENT AND OPERATION	CHARACTE-RISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORDS	AGENCY				REMARKS
									P	W	R	H	
		Overall Dimensions	Major	Measurement	100%	Approved Drawing	As per approved drawing	Inspection Report		2	1		
		Document Review	Major	Review	100%	Approved spec. & drawing	As per approved spec. & drawing	History Docket		2	1	1	
		Painting & Packing	Major	Visual	100%	Approved Procedure	As per approved procedure	Inspection Report		2	1		

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SECTION-1

1.0 SCOPE

This specification shall be applicable to all PHWR Reactors for field painting of buildings, structures, steel surfaces, equipments, piping (over ground and buried), acid & alkali handling areas, electrical and instrumentation panels. This specification does not cover the special type of paints coatings etc. which have been adopted by various vendors or any other special painting system which is adopted for preservation or for transportation purposes.

1.1 AREAS OF APPLICATION

The applications of painting systems in the PHWR have been considered, based on the zoning system i.e. radiation areas and non-radiation areas and has been further classified in the following manner :

1. Painting on concrete as well as concrete plastered and steel surfaces.
   (a) Under radiation field.
   (b) Non-radiation field.

2. Painting system of equipment and piping.
   (a) Under radiation field.
   (b) Inside the buildings.

3. Painting of piping and equipments outside non-radiation field.

4. Special painting systems for acid / alkaline area.
   a) Painting for Battery room area.
   b) Painting for DM plant / chlorination plant.
   c) Painting for Internal coating of GI cladding.

5. Painting for underground / burried piping.

6. Painting for electrical / instrumentation panels.

2.0 APPLICABLE CODES

1.	IS :	5	: 2007	Colour for ready mixed paints & enamels
2.	IS :	5411	: 1974	Plastic Emulsion Paint Part I : For Interior Use
	IS :	2395 Part 1	: 1994	Painting of Concrete, Masonry and Plaster Surfaces - Code of Practice - Part 1 : Operations and Workmanship
		2395 Part 2	: 1994	Code of practice for painting concrete, masonry and plaster surfaces: Part 2 Schedule
3.	IS :	2932	: 2003	Enamel, Synthetic, Exterior : (a) Undercoating (b) Finishing
4.	IS :	2933	: 1975	Specification for Enamel, Exterior, (a) Undercoating, (b) Finishing
5.	IS :	1477 Part I	: 1971	Code of Practice for Painting of Ferrous Metals in Buildings - Part I : Pretreatment
		1477 Part 2	: 1971	Code of practice for painting of ferrous metals in buildings: Part2 Painting
6.	IS :	101	Part 1-9 1969	Methods of sampling and test procedures for paints, varnishes and related products.
7.	IS :	102	: 1962	Ready mixed paint, brushing, red lead, non-setting, priming
8.	IS :	13607	1992	Ready mixed paints, finishing, general purpose synthetic specification.
9.	IS :	133	: 2004	Enamel, Interior: (a) Undercoating (b) Finishing – Specification
10.	IS	159 :	1981	Ready mixed paint, brushing, acid resisting
11.	ISO	8501, 8504		Surface preparation
12	IS	12744	1998	Epoxy red oxide zinc phosphate weldable primer, two components.
13	IS	13467	1992	Chlorinated rubber paint
14	ASTM	D3359		Standard Test Method for measuring Paint Adhesion by Tape Test.

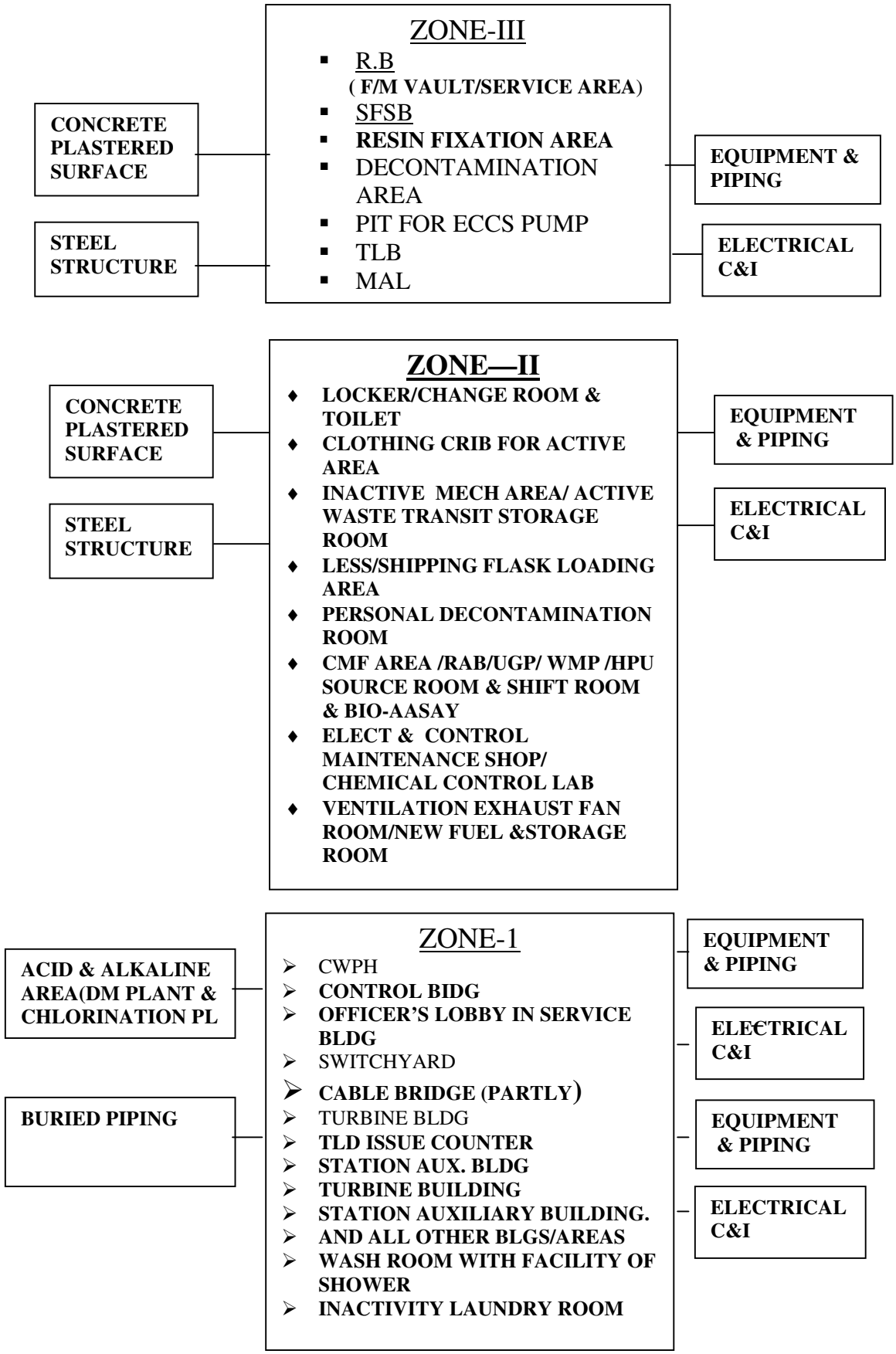
SUPPLIMENTORY SPECIFICATIONS

1	PP-M-399	Vinyl for Epoxy paint for concrete surface
2	PP-E-414	Epoxy resins
3	PP-C-1464	Painting of CS Liners
4	AWWA-C-203	American water works association

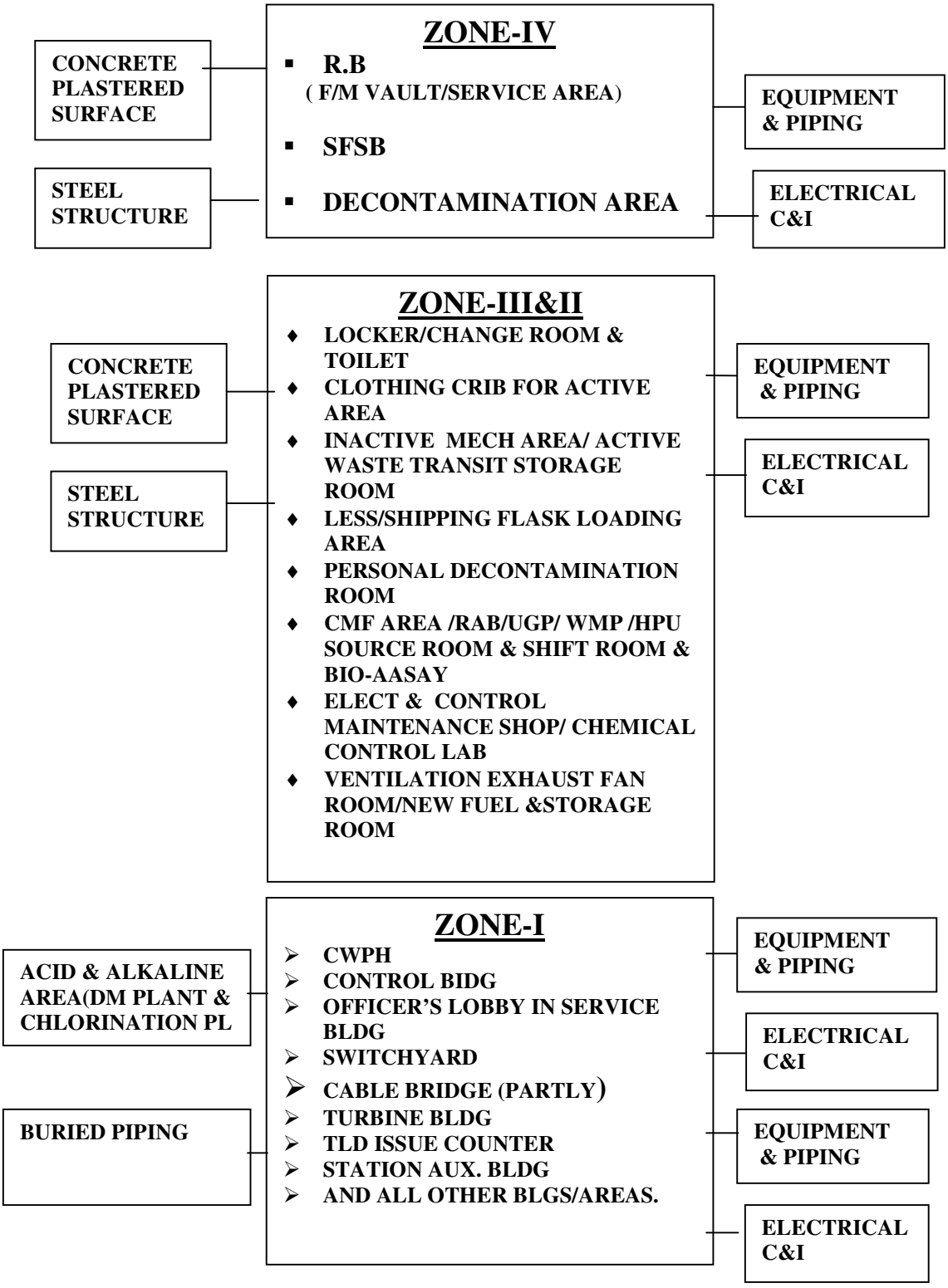
REFERENCE SPECIFICATIONS

1	PP-E-1864	Norms for Piping & Equipment Identification (Color Code)
2	PP-M-1219	Specification for Epoxy Coating for RB Internal Structures
3	PP-M-1729	Technical Specification for Inorganic Zinc

3.0 (A) PAINT APPLICATION AREAS FOR 700 MWe for PHWRs



(B) PAINT APPLICATION AREAS FOR 500 MWe for PHWRs



4.0 PAINTING FOR CONCRETE & PLASTERED SURFACE

4.1 PAINTING FOR RADIATION AREAS

The following painting system shall be adopted on concrete and plastered surfaces in Zone-IV,III & II areas i.e. highly active & radiation prone areas.

Table-1

I) Zone III (Zone IV for 540MWe) and highly active areas e.g. RB, PHT & Moderator purification system areas in RAB, SFSB, decontamination room etc.	**Concrete/Plaster Surfaces**	
	i) Ceilings & Walls	**Paint**: Epoxy paint thickness – 250 microns (minimum)
	ii) Floor	**Paint**: Epoxy paint thickness – 500 microns (minimum)
II) Suppression pool area of RB	**Concrete Surfaces**	
	i) Ceilings, walls not submerged in water	**Paint**: Epoxy paint thickness 700 microns (minimum)
	ii) Floors and walls surface submerged in water	**Paint:** Epoxy paint thickness 1500 microns (minimum)
III) Containment Walls & Containment Dome	**a) Concrete Surfaces**	
	i) Inner face of IC Walls & Dome	**Paint:** Epoxy paint thickness 700 microns (minimum)
	ii) External face of ICW & Dome	**Paint:** Epoxy paint thickness 250 microns (minimum)
	iii) Inner face OCW and Dome	**Paint:** Epoxy paint thickness 250 microns (minimum)
	b) Steel liner Surface	
	i) Face of ICW	**Paint:** Epoxy paint thickness 250 microns (minimum)

4.2 Painting in Radiation Prone Area

Table-2

Radiation Prone Areas of 700MWe (Zone-I &II) & of 540 MWe (Zone I, II & III)	a) Concrete/ Plaster Surfaces		Qualified Paints
ZONE-II ♦ CMF Area ♦ LESS Area ♦ Shipping flask loading Area ♦ New Fuel Storage room ♦ Change room/Showers /Toilet ♦ Personnel Decontamination room	i) Ceiling	Primer : Compatible with Acrylic Emulsion Paint Paint : Acrylic Emulsion Paint	Conforming to IS:5411 & 2395 (Part I & II)
♦ Chemical Lab. ♦ Vent. Exhaust fan room ♦ HPU Shift room & Bio-Assay Lab ♦ Radioactive Source room ♦ HW/UPG ♦ WMP ♦ Control/Elect Maintenance Shop etc. ♦ Active Waste Transit Storage room	ii) Wall (upto 2.5 M from floor level/upto false ceiling level)	Paint: Epoxy Paint (250 microns thick for wall above 1M height and 500 microns thick for floor and wall up to 1M height.)	Conforming to IS:5411 & 2395 (Part I & II)
ZONE-I ♦ Locker & Change room ♦ Clothing Crib for Active area ♦ Inactive Mech. W/Shop etc.	iii) Walls above 2.5 M and upto ceiling	Primer Compatible with acrylic emulsion paint	Conforming to IS:5411 & 2395 (Part I & II)
	iv) Floor	Paint: Epoxy Paint (500 microns Min.)	Conforming to IS:5411 & 2395 (Part I & II)

4.3 Painting for Non-Radiation Zone/Areas

The following painting shall be adopted on concrete and plastered surfaces in non-radiation areas.

Table-3

Non Radiation Zone Zone-I	Concrete/Plaster Surfaces		Qualified Paints
Areas of Service Bldg. and other areas in safety as well as non-safety related buildings. ➢ CCW Pump/house ➢ DM Plant ➢ Chlorination Plant ➢ Switchyard ➢ Officers Lobby in S.B. ➢ Control Bldg. ➢ Turbine Bldg. ➢ SABs (Note-1) ➢ TLD issue centre etc ➢ FWPH ➢ SRPH	Ceilings:	Primer: Compatible with Acrylic Emulsion Paint Paint : Acrylic Emulsion paint	Conforming to IS-5411 & 2395 (Part I & II) Shade of paint for ceiling shall be white.

Notes: 1) For DG Room qualified Epoxy Paint system shall be used.

4.4 **Painting for Special Areas**：

The following painting shall be adopted on concrete and plastered surfaces for special areas.(other than high radiation/radiation prone/non-radiation areas.

Table-4

Special Areas like battery room, Acid/Alkali handling areas	**Concrete/Plaster Surfaces**		**Qualified Paints**
Ceiling Walls & floors.	**Primer:** **Paint:**	Compatible with Acid/ Alkali resistant paint. Acid/Alkali resistant paint	coating system-carboline-893 (125 microns) – carboline – 188 (200 microns) or equivalent from Asian Paints, Berger Paints, AKZO Nobel Paints and Kansai Nerlac Paints.

5.0 Painting for Steel Surfaces/Structures:

5.1 Painting in Radiation areas:

The following painting shall be adopted for painting of steel surfaces. (platform, ladders, handrails etc.)

Table-5

Steel Surfaces /structures (Steel Surfaces in Zone-IV and highly active areas)			Qualified Paints
Steel Surfaces in Suppression Pool Area	Primer: Paint:	Epoxy Zinc based primer. 1 coat of 75 microns Two coats Epoxy paint (Min.thk.250 Microns)	As per Clause no.6.3

5.1.1 Painting for F/M Vault & Service Area (Liners/Panels)

Table-6

F/m vault & F/M Service Area		Qualified Paints	Application
Steel Surfaces in F/M vault & Service areas in RB	Floor Liner Panels	Primer & Painting as per Cause no.6.3	As per Clause no. 6.4

Table-7

Painting of Shielding, & Sealing Doors, Rollon & Fixed Shields, F/M Bridge Carriage & columns, Support frame, Gimble, Top Beam, Fuel Magazine, Supports & Brackets in R.B.		Qualified Paints	Application
Steel Surfaces of above items.	Primer Painting	As per Cause no.6.3	Application as per Cause no.6.5

5.2 **Painting in Radiation Prone Areas – (Zone IV, III& Zone II)**

The following painting system shall be adopted for painting of steel surfaces/ structures in zone-IV, III &II areas.

Table-8

Steel Surfaces/ Structures (Upto 2.5 M from floor level)	**Primer:** Inorganic Zinc silicate primer, one coat of 75 microns **Paint:** Epoxy paint (Min.thk.250 microns)	As per Clause no.6.4

5.3 **Painting in Non-Radiation areas Zone (I)**

The following painting shall be adopted for painting of steel surfaces in zone-I areas.

Table-9

Steel Surface/ Structures	**Primer:** Red Oxide Zinc Phosphate **Paint:** Synthetic Enamel Paint.	Conforming to IS: 12744	Application as per Table-12
	For humid or polluted areas **Primer**-High build chlorinated rubber zinc phosphate. **Paint**: Chlorinated rubber paint	IS:13467	

5.4 **In Special Areas** (Acid/Alkaline area)

Table-10

Steel Surfaces / Structures in Acid / Alkali Handling Area.	Primer: Compatible with Acid/ Alkali resistance paint Paint: Acid /Alkali resistant paint	carbo- mastic – 15 (100 microns) + carboline – 188 (200 microns) or equivalent from Asian Paints, Berger Paints, AKZO Nobel Paints and Kansai Nerlac Paints.

6.0 PAINTING OF EQUIPMENT,PIPE AND SUPPORTS

All the equipment, piping and supports shall be painted with appropriate approved painting system. Colour scheme / identification scheme shall be as per Section-4. Following guidelines shall be followed.

6.1 **Painting for Radiation Areas (Zone-II, Zone-III, Zone-IV areas)**

All the equipment, piping and associated supports in Zone-II, Zone-III, Zone-IV areas i.e. Reactor Building, Reactor Auxiliary Building, Service Building, etc., shall be painted with approved epoxy painting system. Surface preparation for painting shall be as given in the respective paras of this

specification. and a total coating thickness of 250 microns(min.) shall be achieved.

List of qualified epoxy coatings for use on steel surfaces in RB and other main plant structures where epoxy coating has been specified in Table-11.

SN	Description	Qualified Epoxy Coating System	Manuf-acturer	Remarks
1)	Steel surfaces in F/M vault & F/M service areas in RB	Ref. Cl. No. 6.3	Ref. Cl. No. 6.3	Surface preparation shall be done by Abrasive/shot blasting
2)	For steel surfaces other than those mentioned at sl.no.1.	Ref. Cl. No. 6.3	Ref. Cl. No. 6.3	Surface preparation as per manufac turer's recommendations coating thickness 250 microns
3)	Non-Abrasive blasted (Hand tool leaned) steel surfaces (steel surfaces shall be prepared to ST-2 finish prior to application of primer)	Ref. Cl. No. 6.3	Ref. Cl. No. 6.3	Use of these coatings on non-Abrasive blasted steel surfaces is only a compromise and shall be adopted only at locations where Abrasive / shot blasting is not possible due to site constraints.

Table-11

6.2 Painting for Piping & Equipment in Acidic & Saline Areas

All the equipment, piping and associated supports in all the buildings except radiation areas and for areas where special/specific painting system are recommended (eg. Acid/Alkali resistant paints, painting system for saline atmosphere etc.) shall be as per Table-12

Table-12

SL. NO.	DESCRIPTION	TEMP. RANGE	PRIMER	FINISH COAT	MINIMUM TOTAL DFT IN MICRONS
1.	Structural steel work, walk ways, hand rails, ladders, platform etc.	--	Two coats of P1-50 microns per coat minimum	Two coats of F1- 30 microns per coat minimum	160
2.	Uninsulated vessels, heat exchangers, piping, pipe structural steel supports, pumps, blowers, compressors	Upto 65°C	-do-	-do-	160
3.	Identification colour band lettering, numbering etc.	--	--	Two coats of F2	160

NOTE: P1 - High build chlorinated rubber zinc phosphate primer
F1 - Chlorinated rubber paint
F2 - Synthetic enamel

6.3 Epoxy Paints for Steel Surfaces in Radiation Areas (Zone-II, Zone-.III, Zone-IV)

Table-13

Sr. No.	Description	Recommended System	Manufacturer	Remarks
1.	Steel Surfaces in FM Vault & FM Service Areas in RB	DIMETCOAT–6 (Inorganic Zinc Silicate Primer) + AMERCOAT-90 (Epoxy Paint)	M/s. Goodlass Nerolac	This system has been in use in all earlier plants. Recommendation based on performance experience – no qualification tests done.
2.	Abrasive Blasted Steel Surfaces other than those mentioned in Sr. No.1. & Concrete surfaces as applicable	i) APCOSIL 605 (85%) PC2119 (Inorganic Zinc Silicate Primer) + APCODUR CF 641 (Epoxy) OR APCODUR CF 641-CS (Epoxy)	M/s. Asian Paints (I) Ltd.	Qualified to SEC.-III Qualified to SEC.-II Qualified to SEC.-II
		ii) ZINC ANODE-304 NPC (85 %) (Inorganic Zinc Silicate Primer) + PROTECTOMASTIC (Epoxy)	M/s. Berger Paints (I) Ltd.	Qualified to SEC.-III Qualified to SEC.-II
		iii) INTERZINC 1035 (Inorganic Zinc Silicate Primer) + INTERGARD 1054 (Epoxy)	M/s Akzo Nobel Paints	Qualified to SEC.-III Qualified to SEC.-II
		iv) NEROSIL 118 NP (Inorganic Zinc Silicate Primer) + NEROMASTIC400NPK (Epoxy	M/s Kansai Nerolac paints	Qualified to SEC.-III Qualified to SEC.-II & PP-M-988

3.	**Non- Blasted (Hand Tool / Mech. Tool Cleaned) Steel Surfaces, shall be prepared to ST-2 Finish.**	**i) PROTECTOMASTIC** **ii) APCODUR CF-641 CS**	**M/s. Berger Paints (I) Ltd.** **M/s. Asian Paints**	**Qualified to SEC.-II** **Qualified to SEC.-II**

6.4 Application of Paint in F/M Vault & F/M Service Area

6.4.1 Priming

Both sides of all liner plates shall be Abrasive/shot blasted to white metal in accordance with IS : 1477 Part II. Immediately after Abrasive/shot blasting the surfaces to white metal removing completely all mill scale, rust, paint, oil, foreign matter, the surfaces shall be cleaned by air blast and checked to pass the copper sulphate test for cleanliness as per procedure given below, prior to application of paint.

Copper sulphate solution with copper sulphate and water in approximately equal volumetric proportions shall be prepared and filled in a bottle with rubber dropper. The copper sulphate solution shall be applied over the cleaned surface. If the Abrasive/shot blasted surface being tested is clean, the copper sulphate solution when applied will quickly change to a bright reddish copper colour. If Abrasive, iron oxide or any foreign matter is present on the surface, the solution will retain its original colour or may turn black. Surfaces treated with copper sulphate shall be cleaned by Abrasive blasting before painting.

Amercoat Dimetcote No.6, Inorganic Zinc primer shall be applied on both sides of plates immediately after Abrasive blasting, as per the following procedure :

6.4.2 Mixing Procedure

(a) Amercoat Dimetcote No.6 is supplied in two components, a powder and a liquid in the proportions these are to be mixed. Mixing the powder in the liquid in supplied quantities will yield 4 litres of primer paint. The powder (supplied in one container) should be added slowly into the liquid (supplied in second container) thoroughly stirring all the while. These should not be mixed in reverse order as this will cause severe lumping. When a dispersed mixture is obtained it should be strained through a 30-60 mesh screen or cheese cloth. Dimetcote No.6 must be used within 4 hours after mixing. No thinner should be added except when it becomes necessary for workability. If it becomes necessary to use a thinner, use Amercoat 101 as thinner in proportion of 10% maximum.

(b) Five liters of mixed Amercoat Dimetcote No. 6 primer covers approximately 40 sq. meters. As pot life of the mixed paint is only 4 hours, sufficient number of liner plates to be painted should be collected for Abrasive blasting and painting, so that the paint cans once opened and mixed are completely consumed without any wastage. The mixture should be kept in a covered container because exposure to moisture in air, is likely to cause skinning or gelling. Skins formed should be skimmed off the top and gelled material should be discarded.

6.4.3 Application

Dimetcote No.6 primer may be applied using a compressed air spray gun. The pressure on the pot should be between 1 to 2 atmospheres. The air pressure to the gun must be kept as low as possible to avoid dry spray. The gun should be held at 25 to 30 cms from the surface and a wet coat shall be applied with a 50% overlap.

The dry film thickness of coating shall be not less than 50 microns and not more than 80 microns. The thickness of the coating shall be measured with a thickness gauge and recorded. The primer painted surface shall cure and become dry in about 24 hours.

However, as an alternative to the above, the following procedure may be followed:

(a) Vault liners in contact with concrete surfaces:
The liner shall be cleaned with wire brush and applied with 2 coats of red-oxide primer before installation.

(b) Vault liner surfaces exposed to atmosphere:
Liner surfaces shall be grit blasted to near white metal finish and painted with Zinc Silicate Primer (75 microns DFT).

6.4.4 Touch up After Welding

It is not necessary to remove the Dimetcote No. 6 primer from the plates for welding.

After welding and after leakage tests have been carried out as specified in Section 7.0, areas of welds exposed inside the vaults and service areas shall be thoroughly wire brushed and shall be touched-up with Dimetcote No.6 primer/Zinc Silicate primer so as to completely cover all bare metal.

6.4.4.1 Finish Paint System:

Protective Coating applicable for liner surfaces exposed to the atmosphere
The primer painted surface shall be top coated with 2 coats of Amercoat No. 90 epoxy paint. The dry film thickness of each coat shall be about 100 microns.Amercoat No.90 is also supplied in two components, a resin solution and a curing solution. Each component should be first stirred thoroughly in its container. The curing solution should be added to the resin solution in the given proportion and stirred to form an uniform mixure before application. This paint can also be applied using a compressed air spray gun (alternatively airless spray equipment with a pump ratio of 45:1 or higher is recommended.) Dry film thickness of each coat shall be about 100 microns. The second coat shall be applied after allowing the first coat to cure for 24 hours. 4 litres of mixed Amercoat No.90 covers approximately 22 sq. metres of surface in one coat.

The dry film thickness of Dimetcote No.6 primer/Zinc Silicate primer and 2 coats of Amercoat No.90 together shall be 250 to 350 microns.

The painting equipment i.e. spray gun must be thoroughly cleaned immediately after use by cleaner Amercoat 12

6.4.5 Repair of Protective Coating

If the finish painted surface is damaged and repair is needed, it shall be first cleaned to remove any oil, grease or dust particle with a hot detergent wash followed by wiping the surface with xylol. Such surface shall be further cleaned with wire brush or Abrasive paper. Cleaned surfaces shall be painted with one coat of Dimetcote No.6 primer/Zinc Silicate primer and 2 coats of Amercoat No. 90 as described in clause 6.4.4.

6.4.6 Painting of Concrete Surfaces

All concrete surfaces not lined with liner in FM Vaults and FM Service Areas shall be painted with 2 coats of Amercoat No.90 as described in clause 6.4.4 or equivalent painting system as approved by NPCIL. No primer is required for concrete surfaces. However, concrete surfaces before painting with Amercoat No.90 shall be prepared for painting as per the procedure given below:

All concrete surfaces shall be cleaned with detergent followed by rinsing with clean water and then scrubbing using a stiff bristle broom (Abrasive cleaning) to remove loose deposits etc. The surfaces shall be finally air blasted. Humidity of concrete surface shall be checked before application of coating (use Humidity meter or ASTM method).

6.5 Painting of Shielding & Sealing Doors and F/M Bridge Carriage Assembly in Reactor Building:

6.5.1 General

Surfaces of components for which painting is specified on drawings shall be shot/Abrasive blasted and painted after completion of manufacture, shop assembly and shop testing, before packing and dispatch. However, in case of certain components, the surfaces to be painted will not be accessible after assembly; such components shall be finish painted prior to assembly. If painted surface of any component painted prior to assembly is found spoilt after shop tests and disassembly, the same shall be thoroughly cleaned and repainted before dispatch.

All unmachined, machined surfaces other than mating surfaces and inside of Box structure, shall be painted with only Amercoat Painting System. Surfaces serving as reference surface for inspection during installation at site shall be phosphated using chemicals that can be applied by brush. All machined mating surfaces shall be protected by suitable rust preventive.

Amercoat painting system consists of Dimetcote No.6 Inorganic Zinc Primer and Amercoat .90. (Epoxy paint)

6.5.2 Surface Preparation :

All unmachined and machined surfaces required to be painted shall be shot/Abrasive blasted to white metal as per IS:1477 Part II. All important machined surfaces such as mating and reference faces must be adequately protected during shot blasting by covering them with suitable material like plywood sheets, cloth, adhesive tapes etc.

Immediately after shot/Abrasive blasting the surfaces to white metal, removing completely all mill scale, rust, paint, foreign matter, the surface shall be cleaned by air blast and checked to pass the copper sulphate test for cleanliness as per procedure given below, prior to application of paint.

Copper sulphate solution with copper sulphate and water in approximately equal volumetric proportions shall be prepared and filled in a bottle with rubber dropper.
The copper sulphate solution shall be applied over the cleaned surface. If the shot/Abrasive blasted surface being tested is clean, the copper sulphate solution when applied quickly changes to a bright reddish copper colour. If dirt, iron oxide or foreign matter is present on the surface the solution will retain its original colour or may turn black. Surfaces treated with copper sulphate shall be cleaned by shot/Abrasive blasting before painting.

6.5.3 Priming:

Inorganic zinc silicate primer shall be applied immediately after shot-blasting as per following procedure :

a) **Mixing Procedure** :

Dimetcote No.6, is supplied in two parts, a powder and a liquid. Mixing, the powder in the liquid in supplied quantities will yield 4 litres of primer paint. The powder should be added slowly into the supplied quantity of liquid thoroughly stirring all the while. These should not be mixed in reverse order as this will cause severe lumping. When a dispersed mixture is obtained, it should be strained through a 30-60 mesh screen or cheese cloth. Dimetcote No.6 must be used within four hours after mixing. No thinners should be normally added. However, if it becomes necessary for workability, add upto a max.10% by volume of Amercoat No.101.

b) Four litres of mixed Amercoat Dimetcote no. 6 primer covers approximately 20 sq. meters. As pot life of the mixed paint is only four hours, sufficient number of components to be painted should be collected for shot blasting and painting so that the paint cans once opened and mixed are completely consumed without any wastage. The mixture should be kept in a covered container because exposure to moisture in air is likely to cause skinning or gelling. Skins formed should be skimmed off the top and gelled material should be discarded.

c) Application

Dimetcote No. 6 primer may be applied using a compressed air spray gun. The pressure on the pot should be between 1 to 2 atmosphere. The air pressure to the gun must be kept as low as possible to avoid dry spray. The gun should be held at 25 to 30 cms. from the surface and a wet coat shall be applied with a 50 percent overlap.

The dry film thickness of coating shall be not less than 50 microns and not more than 80 microns. The thickness of the coating shall be measured with an Thickness gauge and recorded. The primer painted surface will cure and become dry in about 24 hours.

6.5.4 Finish Paint System:
Refer para 6.4.4.1

6.6 Painting of structures, systems and equipment located outside R.B.

The following surfaces and material shall require painting.

1) All structural steel work inclusive of platforms, ladders, walkways, supports for piping systems and equipments etc.
2) All uninsulated carbon steel, G.I and low alloy steel piping systems complete with fittings, valves, etc.
3) All uninsulated equipment like storage tanks, air receivers, pressure vessels, etc.
4) Equipment and piping contained in a packaged unit as necessary.
5) Identification colour bands on all piping systems including stainless steel, galvanised, non- ferrous, insulated and cladded pipe lines
6) Identification lettering/numbering on equipment, piping systems, etc.

The following surfaces and materials do not require painting unless specifically mentioned :

1) Non-ferrous materials
2) Plastic and/or plastic coated material

6.6.1 GENERAL REQUIREMENTS

Any painting work including surface preparation shall be taken-up only after the item to be painted has been inspected and tested and clearance for painting is given. No painting shall be done in frosty/foggy weather or when the humidity is high enough to cause condensation on the surface to be painted.

Paint shall not be applied when the temperature of the surface to be painted is 5°C or below.

Primer and finish paint for any particular system shall be from the same manufacturer to ensure compatibility.

Paint manufacturer's instructions regarding storage, mixing and application of paints shall be followed at all times.

Mechanical mixing shall be adopted for all paint mixing operations except at very rare locations in small quantities at the discretion of Purchaser.

Particular attention shall be paid to the following aspects.

1. All paint procured shall be ready mixed, in original sealed containers as packed by the manufacturer.

2. Proper storage of paints shall be arranged to avoid exposure to adverse weather conditions and temperature extremities.
3. Mixing and thinning of paints.
4. Surface preparation prior to application of paints.
5. Maintaining the pigment in suspension by frequent stirring of the paint.
6. Maintaining recommended limit on time intervals between application of successive coats.

6.6.2 SURFACE PREPARATION

6.6.2.1 GENERAL

In order to achieve maximum durability one or more of the following methods of surface preparation shall be followed depending on condition of steel surface. Adhesion of the paint film to surface depends largely on the degree of cleanliness of the metal surface. Proper surface preparation contributes to the success of the paint protective system.

(a) Manual or hand tool cleaning

(b) Mechanical or power tool cleaning

(c) Shot/Abrasive blast cleaning

(d) Solvent cleaning

Mill, scale, rust, rust scale and foreign matter shall be removed fully to ensure that a clean and dry surface is obtained. All other contaminants, grease, oil, etc. shall be removed by use of an aromatic solvent prior to surface cleaning.

Blast cleaning shall not be performed where dust can contaminate surfaces undergoing such cleaning, or during humid weather conditions having humidity exceeding 85%.

Irrespective of the method of surface preparation the first coat of primer must be applied by brush/spray on dry surface. This should be done immediately and in any case within 4 hours of cleaning of surface. However, at times of unfavourable weather conditions, re-cleaning may be required, before primer application is taken up. In general, during unfavourable weather conditions blasting and painting shall be avoided as far as practicable.

Manual or Hand Tool Cleaning

(a) Hand de-scaling and/or hammering
(b) Hand scraping
(c) Hand wire brushing

Rust, mill scale spatters, oil coatings and other foreign matter shall be removed by hammering, scraping tools, emery paper cleaning, wire brushing or combination of the above methods. On completion of cleaning, loose material shall be removed from the surface by clean rags and the surface shall be removed from the surface by

clean rags and the surface shall be brushed, swept, de-dusted and blown off with oil free compressed air to remove all loose matter.

Mechanical or Power Tool Cleaning

Power tool cleaning shall be done by mechanical striking tools, chipping hammers, grinding wheels or rotating steel wire-brushes. Excessive burnish of surface shall be avoided as it can reduce paint adhesion. On completion of cleaning, the detached rust mill scale etc. shall be removed by clean rags and/or washed by water or steam and thoroughly dried with oil free compressed air jet before application of paint.

Blast Cleaning

The surfaces shall be blast cleaned using Abrasive shot or chilled cast iron or malleable iron and steel maintaining constant velocity and pressure. Chilled cast iron, malleable iron and steel in the form of shot or grit of size not greater than 1.5 mm maximum in case of steel and malleable iron, and 1.0 mm maximum in case of chilled iron. Compressed air shall be free from moisture and oil. On completion of blasting operation, the blasted surface shall be clean and free from any scale or rust and must show a grey white metallic luster.

6.6.3 PAINT APPLICATION

After the surface preparation is over, the primer shall be applied immediately and in any case within four (4) hours of surface preparation. The primer should be worked either by brush application or spraying on the cleaned surfaces to cover the crevices, corners, sharp edges etc. The number of coats shall be in accordance with paint schedule

Finish paint in required number of coats shall be applied after the primer has dried-up completely. The shades of successive coats shall be slightly different in colour in order to ensure application of individual coats. The thickness of each coat and complete coverage shall be checked as per the paint schedule, before the next coat is applied. Mechanical means of applying finish paint is preferred to manual working to ensure uniform film thickness, appearance and faster execution.

Surfaces inaccessible after assembly shall receive an additional coat of the specified paint prior to assembly. All machined surfaces shall be provided with a coat of white lead or tallow to prevent formation of rust on these surfaces.

After the item has been erected at site, all bare and abraded spots, rivet heads, field welds, bolt heads and nuts shall be spot painted with primer followed by finish paint. Before the paint is applied, the surface shall be dry and free from dust, dirt, scale, oil and grease. Surfaces inaccessible after erection shall receive an additional coat of the specified paint prior to erection.

It should be ensured that the painted surfaces of items are not abraded/scratched etc. as they leave the place of manufacture/ fabrication, and received at site in good condition. Otherwise, all damaged/abraded/scratched surfaces shall be touched-up on receipt of the item at site.

Shop painted items may not be requiring repainting at site unless the paint is damaged and repainting is asked for. In case of any repainting at site, the areas where the painting is damaged or peeled off shall be thoroughly cleaned by rubbing down with emery paper to remove rust, dust and any foreign matter, washed with a degreasing agent like white spirit to remove grease/oil if any, and dried with air. One coat of primer shall then be applied followed by finish paint. It shall be ensured that both the primer and finish paint are the same as specified and used during shop painting.

Finished painted surfaces shall present an aesthetically pleasing appearance free from dusts and uneven surfaces. Shades for finish coats and that required for identification colour band, lettering numbering etc. shall be as per Section-4.

6.6.4 IDENTIFICATION MARKING

Equipment numbers, pipe line numbers, flow direction, hazard symbols etc. shall be as per Section-4 of this specification.

6.6.5 INSPECTION AND TESTING

All painting materials including primers and thinners for application shall be procured from approved manufacturers as per specifications and shall be accompanied by manufacturer's test certificates. In case such certificates are not available, materials may be tested in accordance with relevant specifications in approved laboratories.

The painting work shall be subject to inspection by Purchaser at all times. Stage wise inspection shall be performed before proceeding to the next stage. The record of inspection shall be maintained. Stages of inspection are as follows

1. Surface preparation
2. Primer application
3. Each coat of paint

Any defect noticed during the various stages of inspection shall be rectified before proceeding further. Dry film thickness (DFT) shall be checked and recorded after application of each coat.

Final inspection shall include measurement of paint dry film thickness, check of finish and workmanship. The thickness should be measured at as many points/ locations as required and shall be within 10% of the dry film thickness specified.

7.0 PROCEDURE FOR SURFACE PREPARATION AND PAINTING ON EXTERIOR SURFACE OF PIPING, EQUIPMENT OF FIRE PROTECTION SYSTEM.

This document describes the procedure for surface preparation and application and inspection of primer & finished paint on exterior surfaces of supports, piping, pipe components & equipment.

The purpose of this procedure is to provide guidelines for surface preparation and painting on exterior surfaces of structural steel, pipes and Equipment of Fire Protection System.

This procedure is applicable for painting of outer surface of piping and structural work of Fire Protection System.

7.1 **Surface Preparation**:

7.1.1 **Wire brushing/Power Tool Cleaning/Compressed air cleaning**

Loosely adhering mill scale & spatters will be removed by chipping hammer, scrapping tool, old protective coatings and rust will be removed by emery paper, brushes or combination of the above methods or with I) Disc Abrasivers, 2) Power Brushes to ST-2 std.

7.1.2 Any other surface preparation method as recommended by paint manufacturer.

On completion of cleaning, loose material will be removed from the surface by clean rags and the surface shall be brushed, swept by oil free dry compressed air, to remove all loose matters.

7.2 Painting:

7.2.1 Mixing and Thinning :

The paint manufacturer's recommendation shall be followed for mixing, thinning and storage, application of paint, drying time and weather condition. The left out paint will be preserved in a drum with tight cover (applicable only for single pack Alkyd paints).

7.2.2 Application of paint.

(i) Paint application shall be carried out by either conventional spray, or by hand brush as per recommendation of manufacturer by a qualified painter

(ii) If there is rain just after application and before drying then protection of paint will be done by covering the materials under paint with tarpaulin sheets.

(iii) Area not to be painted before hydro testing

- Welded joints of the pipe (During shop painting but shall be painted after testing of systems).
- Ends of the Pipe. (-Do-)
- Identification mark. (-Do-)

Area Excluded from Painting:

- Machined and threaded surface.(Mechanical Joint)
- Flange faces will be covered prior to painting.
- Nameplates.

(iv) Surface shall not be coated in foggy/frosty weather or when the steel surface temperature is less than 5^0C or where relative humidity is greater than 85%.

(v) a) Drying time shall be followed as per manufacturer's instructions.
b)Paint manufacturer's recommendations for the period (minimum, maximum) between two successive coats shall be strictly adhered to.

(vi) Paint film thickness will be maintained as indicated below :

For primer HB Zinc Phosphate Primer Grey- DFT=35-50 microns per coat
For HB MIO-DFT=50-60 micron per coat
For finish coat paint -DFT=100–125 microns each coat inside RB and RAB
For Epoxy – DFT=100–125 microns each coat inside RB and RAB

(vii) All runs and sags shall be brushed out immediately or the paint shall be removed and surface will be re-painted.

(viii) In case of air spray application, traps or separators shall be provided to remove oil and condensed water from the air.

(ix) When paint has been damaged, all damaged and loosely adhering paint shall be removed and surface shall be cleaned mechanically to bare metal. Priming shall be done in the area with primer specified to the required DFT. Then 2nd, 3rd & 4th coat paint shall be applied as per specification.

(x) Primer and finish paint for any particular system shall be from the same manufacturer to ensure compatibility.

(xi) For Galvanised Pipes surface cleaning will be done by coat Etch primer & followed by MIO and finish coats excluding primer coat. For De-galvanised & Welded Portion of the same, all the four coats will be done as described in this procedure as for outside RB&RAB.

7.3 INSPECTION:

7.3.1 Following points for Inspection and checking shall be taken into account. Stage wise Inspection shall be carried out on the work before proceeding for the next stage. Surface preparation can be inspected visually. The profile should be ST-2 standard or minimum paint manufacturer's recommendation for primer application. Proper application of primer/ paint can be checked by measuring DFT. DFT shall be measured with the help of calibrated the gauge at every stage.

7.3.2 TEST FOR PAINT ADHESION:

If a coating is to fulfil its function of protecting a substrate, it must adhere to it for its service life. Because the substrate and its surface (or lack of it) has drastic effect on the adhesion, a method of evaluation for adhesion of a coating to different substrates, or of different coatings to same substrate is of considerable usefulness for the job. Paint adhesion shall be checked as per the ASTM D 3359 or using Portable Adhesion Tester.

7.4 ACCEPTANCE CRITERIA:

a) For the rating 3A, 4A 5A Painting is acceptable.

b) For the rating 2A & below i.e. for 2A, 1A, 0A the painting should be completely removed and fresh surface preparation will be done and painted again.

c) Final DFT of paint shall be 160 micron + 10% tolerance for outside RB&RAB.
Final DFT of paint shall be 250 to 300 micron inside RB & RAB.

7.5 STORAGE:

All paints and painting materials shall be stored in original seal container as packed by manufacturer. Proper storage of paints shall be arranged to avoid

exposure to adverse weather conditions & temperature. All necessary precautions shall be taken to prevent fire. The storage building shall preferably be separate from adjacent building. A signboard bearing the words "PAINT STORAGE", NO NAKED LIGHT – HIGHLY INFLAMMBLE". "NO SMOKING" shall be clearly displayed outside

SECTION-2
(Refer PP-M-1219)

1.0 Technical Specification for Epoxy coating for Reactor Buliding internal structure and Equipment

The epoxy coating would be used for painting the concrete floors, ceilings and walls; mild steel, carbon steel and stainless steel surfaces of equipment and piping, inorganic zinc silicate primed steel surfaces; construction joints caulked with polysulphide caulking compound, metallic expansion joints made from steel and copper etc. The materials used in the coating should not form radioactive isotope on absorbing neutrons. The paint system should form a thick, radiation resistant, abrasion resistant, impact resistant, non-adsorbent, decontaminable, humidity resistant, hot water & steam resistant protective film/liner.

1.1 MATERIAL (Generic type)

Polyamide cured two pack epoxy coating in mix-and-use form comprising:

i) A non-inhibitive primer with outstanding wettability and adhesions.

ii) A high build body coat.

iii) A smooth, high gloss decontaminable finish/top coat.

1.2 SAMPLE

The samples shall be accompanied by a qualification certificate containing results of the various tests specified in of the para 2.0 of this Section

1.3 QUALIFICATION

Qualification of the samples shall be carried out in accordance with the requirement of the para 2.0 of this specification. The qualification tests are to be conducted in a test laboratory/agency of repute such as India Institute of Chemical Technology (formerly R.R. Lab), Hyderabad, Butler Technological Institute Kanpur or National Test House or a testing laboratory/agency. Guidelines for preparation of test panel are given in the para 2.0 of these specifications.

For coating samples meeting all other requirements of this specification nuclear tests such as radiation resistance, decontamination and LOCA exposure tests may be carried out at Bhabha Atomic Research Centre (BARC) by submitting samples as indicated in para 2.0

At the time of bulk supply samples shall be drawn from each batch in presence of purchasers representative, sealed and supplied for determination of replicability in accordance with the tests mentioned in para 2.0

1.4 APPLICATION OF COATING

The coating is intended to be applied by Airless Spray gun normally with pressure ratio of 45:1 with a flow characteristic of 5 lpm at 120 b to 1 lpm at 210 b would be used at a nominal air pressure of 7 kg/sq.cm (g) with fluid tips of various sizes and fan angles with a fluid output in the range of 1 to 2.75 lpm and fan width of 33 to 43 cms. In addition, depending on the intricacy of the substrate and the quantity of coating used, brush or conventional spray may be used. Coating shall, however, be designed and manufactured for application by airless spray unit described above.

1.5 TECHNICAL DATA

The following technical data to be verified.

1.5.1 Ingredients used in the paint sample.

1.5.2 Results of the tests carried out at their own laboratories and or national laboratories (Ref. Sec 5, 9 & 15).

1.5.3 Mixing ratio of the packed components.

1.5.4 Method of application.

1.5.5 Recommended wet film deposition per coat without loss of mechanical properties and uniformity of the film (i.e. without sagging or dripping) on horizontal bottom and vertical surfaces.

1.5.6 Dry film thickness of the coating for the recommended wet film thickness.

1.5.7 Pot life.

1.5.8 Post mixing, in-pot curing if any.

1.5.9 Use of sieves and powered mixing, if any, before the airless spray application.

1.5.10 Method of application, fan size, overlap, cross coating, distance of spray nozzle from surface on which coating is applied.

1.5.11 Coverage per unit volume of coating at the recommended thickness.

1.5.12 Recommended time period between two successive coats.

1.5.13 Surface preparation both for first application and surfaces coated with aged polyamide epoxy coating.

1.5.14 Ventilation and breathing apparatus requirements, if any.

1.5.15 Hazards involved in handling and application, precautionary measures to be taken, first aid methods and methods for monitoring air concentration of any ingredient which could be injurious to health.

1.5.16 Recommended thinner required if any for brush/conventional spray application and the mixing ratio and other requirements.

1.6 PREPARATION OF TEST SPECIMEN

Carbon steel IS 2062) panels shall be prepared in accordance with IS 101-1964. Amongst others, test specimen of following dimensions may be useful for the tests described in para 2.0 of this Section.

a) Panel 150 mm x 100mmx 1 to 3mm thick.
b) Panel 100 mm x 50mm x 1 to 3mm thick.
c) Panel 50mm x 50mm x 1 to 3mm thick.
d) Disc 32mm dia x 0.5 to 1mm thick.
e) Right cylindrical rods 25mm dia, 150mm long.

1.6.1 Tin Panels.

Tin panels of dimensions 100 mm x 50 mm x 0.315 mm for flexibility test.

Concrete Panels

Concrete panels are to be prepared with aggregate size approximately one third of the minimum dimension of the test specimen. All concrete panels shall be cured at standard conditions of temperature and humidity for a period of 28 days before application of coating. Amongst others, test panels of following dimensions may be useful for the tests described in para 2.0 of this Section.

a) Panel of 150mm x 100mm x 12mm.
b) Panel of 100mm x 50mm x 12mm.
c) Panel of 50mm x 50mm x 12mm.
d) Panel of 150mm x 25mm x 25mm.

1.6.2 **Special Panels**

Carbon steel, concrete or other panels or required dimensions may be used to meet the requirements of non standard test, if any.

1.6.3 Free Films

Free films shall normally be prepared on glass supported tin foils by usual method of application. Free films by other methods may be prepared subject to approval of the purchaser. Amongst others, free films of following dimensions may be useful for the tests described in para 2.0 of this Section.

a) 100mm x 10mm x thickness of primer/system.
b) 100mm x 100mm x thickness of the system (if the coating is intended to be applied on containment boundary).

1.7 Surface Preparation.

1.7.1 Steel Panels

Surface preparation of the tin panels shall be in accordance with the requirements of the tests specified in para 2.0 of this Section.

1.7.2 Concrete Panels:

Surface preparation of the concrete panels shall be in accordance with the requirements of the tests specified in para 2.0 of this Section. The surface preparation methods may include cleaning with detergent followed by rinsing and desiccant drying, wire brushing etc.

1.7.3 **Application of Coating** (for test specimen)

Application of the coating for preparation of the test specimen shall be by airless spray except where the property to be determined is independent of method of application and where the test method calls for panel preparation by a method other than airless spray.

1.8 QUALITY ASSURANCE

A quality assurance document providing following information on

a) Inspection of surface of substrate; methods and acceptable range of surfaces. Preparatory steps, checks, tests and range of parameters while preparing the coating for application.

b) Methods & procedures for controlling the rate of material deposition on the substrate & thickness of wet film along with methods of inspection and acceptable range of parameters.

c) Procedure for initial and in service inspection of the coated surface, detection of flaws and repairs.

1.3 TEST RESULTS

Test results should be tabulated against the required property values given in para 2.0 of this Section and submitted. Coated panels for nominal dimensions as per clause no,. 1.9 and 1.10 of this Section shall be submitted to BARC for the radiation resistance, decontamination and LOCA exposure tests.

2.0 Test requirements for Epoxy Coating for RB internal structure and equipment

P-Primer Coat; B-Body Coat; F-Finish Coat
S-System (multicoat);
> : Greater Than < : Less Than

S.No.	Test	Method	Reqd. property value Ref PP-M-1219
1.	Fineness of dispersion Hegmann gauge (0.004")	ASTM D 1210- 1979	P & B >3(or <60 microns) F > 7 (or<12 microns)
2.	Volume solids (%)	IS 101- 1964 Or ASTM D 2697, 86	P > 50 B > 75 F > 50
3.	Flash point for primer body and finish	IS 1011964	> 30 deg.C
4.	Pot life at 30 deg C.		> 45 min
5.	Shelf life at 30 deg. C		> 180 days
6.	Drying time – B&K recorder	Paint technology Manual Part V,	Surface dry< 3 hr hard dry < 18 hrs
7.	Coverage (M2/litre)		P:@ 50 micron DFT >10 B:@ 150 micron DFT >5 F:@ 50 micron DFT >10
8.	Dry film Thickness/coat when applied in accordance with Sec-6 of this space.	ASTM D 1005.84	P > 50 micron B > 150 micron F > 50 micron
9.	Total dry film thickness	ASTM D 1005, 84	Ceilings, walls & equipment (1P+1B+1F) DFT 250 microns Floors & wall upto 1 m height from floor(1P+2/3B +1F) DFT 500 microns. This combination is Identified as coating System for testing.
10.	Colour	IS 101	B:Silver grey (628) & Vellum (365) F: Vellum (365)
11.	Gloss (60 deg.)	ASTM D523	S/F > 70
12.	Salt spray	IS 2074 - 1979 or ASTM B 117,1985	System should pass 21 days exposure without blistering or corrosion.
13.	Protection against corrosion in humidity cabinet.	IS-1011964	System should pass 21 days exposure without blistering or corrosion.
14.	Viscosity (Kinematic) AT 25 deg.C in stokes	See Note-1	P 3 to 4 B/F 8 to 10

15.	Scratch hardness (kg)	IS 101	F > 2
16.	Rocker hardness	-do-	S>15
17.	a) Practical Adhesion by Abrasivewitch pull off b) Failure in cohesion in Body/top coat	ISO-4624 DIN-9	P > 300 Kg/cm2 S > 200 Kg/cm2 > 80%
18.	Tensils strength-Kg/cm2	ASTM D 2370-1982	S > 100
19.	% elongation under load at the point of break	ASTM D 2370-1982	S > 6
20.	Water vapor permeability gm/m2-hr/mil	ASTM D 1653-1985	S < 4
21.	% water absorption on free film.	RRL method (see-Note-2)	S < 6
22.	Abrasion (Dry) resistance (mg/1000 cycle)	RRL method (Modified sheen wet abrader) (See Note 3)	S< 25
23.	Flexibility (Test panel bent On ½ inch dia cylindrical Mandrel)	ASTM D1737-1985	System should pass free from detachment crack, surface deformation etc.
24.	Impact resistance – Direct impact of 10.5 lbs Falling from 23 inch height	DEF – 1050	System should pass free from cracking, at the peak or periphery of the bulge.
25.	Resistance to eight different conditions of test as following a) Distilled water - 4 weeks b) Deionised water - 4 weeks c) 2% Nitric Acid Solution - 4 weeks d) 5% NaOH solution - 4 weeks e) 5% detergent (eg. Teepol) - 4 weeks f) Petrol - 4 weeks g) Hot water at 95 deg.C - 1 hr for 40 cycles h) Steam impingement (saturated) at 2 Kg/CM2g for 15 mins	IS 101-1964 IS 159-1972 ASTM D 1308 1973	System should pass free from defects like blistering, loss of colour and adhesion.
26.	Accelerated weatherometer (500 hrs) observations in following properties :	IS 2932 1974 or ASTM D4587, 86	System should pass

	a) Chalking b) Checking c) Cracking & Blistering d) Loss of gloss e) Loss of colour f) Water spotting		
27.	Decontamination factor (DF)	BARC Method	> 100
28.	Loss of coolant accident (LOCA) environment after preconditioning for 40yrs aging at 45 deg. C & 100 Mega Rad gamma Exposure (a) Steam (Saturated) exposure at 110 deg. C for 1 hr	ANSI N 5.12 1974	Free from blisters bulging, bilging delamination & detachment from substrate
29.	Radiation resistance (100 Mega Rads) Ref: Sec. II	ANSI N5.12 - 1974	System should have no visible change such as chalking, checking cracking, blistering delamination, tackiness, loss of gloss & loss of colour (in M.S. & concrete panels)
30.	Fire resistance	ASTM-E-84	Flame spread index<20 Smoke density factor< 70

Notes

i). Viscosity may be measured by any one of the following methods depending on the suitability.

a) Ford cup No.4 (ASTM D1200) or
b) Stormer viscometer (ASTM D 562) or
c) Brookfield viscometer.

The results, however, shall be reported in stoke or poise along with density (specific gravity) of the paint.

ii) About 100 x 75 mm free film is immersed in redistilled water for 7 days. The wet film then is transferred between the folds of filter paper and pressed gently to remove surface water. The film is weighed and transferred to a dessicator. After 7 days of drying, film is removed from dessicator and weighed immediately. The difference of weight is water absorbed.

iii) Panel mounted in the sheen wet abrader with 500g load is placed on Fine emery paper no. 180. Weight loss measured following 1000 cycles of dry abrasion.

iv) Testing Laboratories/Agencies

- Physical, Chemical & Mechanical properties — a) Indian Institute of chemical Technology (Formerly RR Lab), Hyderabad.

	b)Harcourt Butler Technological Institute Kanpur.
• Radiation Resistance, Decontamination and Loss of coolant accident exposure tests.	Bhabha Atomic Research Centre, Bombay.
• Fire resistance	Central Building Research Institute, Roorkee.

3.0 PAINTING OF CONCRETE SURFACES WITH EPOXY PAINT

This describes the procedure for painting concrete surfaces with heavy duty high build Epoxy Paint system. This procedure shall be applicable to all main plant buildings.

3.1 Material Specification

Epoxy paint, a two-pack system consisting of a Base and Catalyst (Hardener) shall conform to the requirements of tender technical specifications, applicable for reactor containment, suppression pool, boundaries of reactor buildings and for reactor building internals as well as for other buildings/areas respectively.

All the brands of paint system shall only be accepted with prior approval of NPCIL.

3.2. Application for approved epoxy paint for paint system.

Application details for various approved brands shall be as follows :

Table – 14 – Requirement of Epoxy paint system

Application Parameter	Requirement of paint system		
	Apcodur - CF 641	**Amerlock -400**	**Protectomastic**
1. Mixing ratio	2 base: 1 hardener	1 part resin : 1 part cure	Base : catalyst – 1:1 by volume
2. Pot Life	120 minutes (at 30° C)	90 minutes (at 32° C)	90 minutes (10% thinned)
3. Drying time Surface dry (touch) Hard dry Full cure	 4 hrs. 16 hrs. 7 days	 4 ½ hrs. 12 hrs. 4 days	 3 hrs. 18 hrs. 7 days
4. Recommended Thinner	T - 142	Amercoat 8 or 65	Thinner 844
5. Surface preparation	As per manufacturer's recommendations		
6. Over coating interval at 30° C	16 hrs. (Min.) 72 hrs. (Max.) provided surface is dry and clean from all contamination	8 hrs. (Min.) at 21° C	Overnight. Depending on Conditions.
7. Recommended DFT per coat	75 to 150 microns	125 to 200 microns	125 to 175 microns

3.3 Equipments / Instruments / Accessories required :

1) Airless spray gun with all connecting pipes.
2) Compressor capacity 300 cfm to 450 cfm.
3) Mechanical agitator

4) Paint thickness measuring instrument for wet & dry film thickness
5) Thin MS sheet or Mask tape

3.4 Surface preparation

Oiled concrete surfaces shall be washed with detergent and then rubbing with No.60/80 emery paper and then cleaned with clean cotton cloth.

Prior to taking up of painting, any imperfections, bulging, offsets in concrete shall be ground, chipped and made to F3/U3 finish.

Gradual irregularities for unformed surfaces will be to maximum of 6.0mm in 1.5m length & 6.0mm in 3.0m length for formed surfaces.

Air water jet shall be forced through a nozzle (with an orifice of about 15mm) to strike on the concrete face, at a pressure of approx. 7 kg. per sq.cm. in order to open out air holes and to remove laitance present on the surface. Nozzle for air jet shall be at a distance of 300mm from outer surface and shall be held in horizontal position. The surface shall be wiped with a clean cloth.

Any further stringent surface preparation requirements in case, recommended by manufacturer shall be adhered to.

3.5 Paint application :

Embedded parts visible on the concrete surfaces shall be covered with mask tape, nearby equipment & pipes shall be suitably covered by polythene sheets to protect them against splash of paint.

Paint shall be applied in number of coats as required to achieve the specified coating thickness as specified in the relevant construction drawings / specifications. DFT of each coat shall be as per manufacturer's recommendations.

Application details for the primer / paint coats including inter coat time gaps and method shall be as per manufacturer's recommendations.

Paint shall be sprayed uniformly and without sag on all edges and into the corners. Nozzle shall be held close to the surface being painted so as to avoid evaporation of volatile constituents.

Painting on vertical surface shall start from the top and shall be worked down. Further, painting on floors shall start from one corner and gradually proceed towards the exit.

Paints may be applied with paintbrush only in specific areas where use of spray gun is not feasible, with the due permission of NPCIL engineer.

For measurement of paint thickness, thin MS sheets shall be fixed on the surface to be painted at the selected locations with the help of tape. This plate shall be removed after drying of every coat and the thickness of paint on it shall be measured using a

thickness gauge. This shall represent dry film thickness of the particular coat of paint. During painting wet film thickness shall be measured using comb gauge. Alternately insitu DFT shall be measured using a ultrasonic thickness gauge.

3.6 Safety Measures:

i. Painters and their helpers handling epoxy paint system shall be provided with rubber / polythene gloves.
ii. As the paint is highly volatile, painters engaged for spraying of epoxy shall wear nose / mouth masks / air respirators.
iii. Fans / blowers for proper ventilation shall be provided in the confined area during the painting process.
iv. Sufficient lighting arrangements shall be ensured before start up of painting work.
v. Staging and scaffolds shall be deployed for painting at heights above 2 M.

In addition to above all other safety measures as recommended by manufacturer shall be adopted.

3.7 Inspection Record:

Following records shall be generated for the painting works:

1) Material (Paint & toweling compound) batch acceptance reports duly signed by NPCIL along with all the material reports.
2) Stage wise painting inspection reports.

SECTION-3

(Refer PP-M-1729)

1.0 Technical Specification for INORGANIC ZINC SILICATE PRIMER

The specification covers technical requirements of self-curing Inorganic Zinc Silicate primer, for application on steel surfaces both inside and outside Reactor building of Nuclear Power Projects.
A two pack system in mix and use form comprising:

i) Liquid part (Ethyl silicate Binder)
ii) Powder (Zinc dust)

The primer would be used for painting steel structures and equipments both inside and outside the reactor building, after adequate surface preparation. The materials used in the coating should not form radioactive isotope on absorbing neutrons.

1.1 QUALIFICATION :

Qualification of coating system as per para 2.0 of this Section is to be carried out by the supplier. For the tests, samples coated on substrates, in accordance with per para 2.0 of this Section.
The samples shall be made using the same materials, composition and process, in all respects as that to be used in the manufacture of the paints.

The samples previously qualified to the requirements specified in per para 2.0 of this Section may be tested only for the critical parameters as specified in per para 3.0 of this Section.

1.2 APPLICATION OF COATING:

The coating is intended to be applied by Airless Spray gun with pressure ratio of 23:1 would be used at a nominal air pressure of 7 kg/cm^2 with fluid tips of various sizes and fan angles. In addition, depending on the intricacy of the substrate and the quantity of coating used conventional spray may be used. Coating shall however, be designed for application by airless spray unit described above.

The substrate to be coated shall be cleaned by suitable methods. Surface preparation shall be to SA-2.5 or equivalent with a blast profile of 50-70 microns.

1.3 TECHNICAL DATA

The following technical data to be verified.

1.3.1 Ingredients used in the paint sample.
1.3.2 Results of the tests carried out at their own laboratories and/or national laboratories.

1.3.1 Mixing ratio of the packed components.
1.3.2 Method of application.
1.3.2 Recommended wet film deposition per coat without loss of mechanical properties and uniformity of the film (i.e. without sagging or dripping) on horizontal top, horizontal bottom and vertical surfaces.
1.3.3 Dry film thickness of the coating for the recommended wet film thickness.
1.3.4 Pot life and flash point.
1.3.5 Post mixing, in-pot curing if any.
1.3.6 Use of sieves and powered mixing if any before the airless spray application.
1.3.7 Method of application, fan size, overlap, cross coating, distance of spray nozzle from surface on which coating is applied.
1.3.8 Coverage per unit volume of coating.
1.3.9 Recommended time period before top-coating.
1.3.10 Surface preparation both for first application and subsequent coating with suitable top coat.
1.3.11 Ventilation and breathing apparatus requirements.
1.3.12 Hazards involved in handling and application, precautionary measures to be taken and first aid methods.
1.3.13 Recommended thinner required if any for conventional spray application and the mixing ratio and other requirements.
1.3.14 Certificate of Non Toxicity for ingredients used

1.4 PREPARATION OF TEST SPECIMEN:

1.4.1 **Steel Panels** : **Material and Dimensions**

Carbon steel panels shall be prepared in accordance with IS 101-1964. Amongst others, test specimen of following dimensions may be useful for the tests described in para 2.0 of this section.

a) Panel 150 mm x 100 mm x 1 to 3 mm thick
b) Panel 100 mm x 50 mm x 0.3 to 0.5 mm thick
c) Panel 50 mm x 50 mm x 1 to 3 mm thick.
d) Disc 32mm x 1 to 3 mm thick.

1.4.2 **Special Panels** :
Carbon steel or other panels of required dimensions may be used to meet the requirements of non standard tests, if any. \

1.4.3 Surface preparation:
Steel panels: Surface preparation of the steel test panels shall be in accordance with the requirements of the tests specified in para 2.0 of this section. The surface preparation methods may include removal of mill scale, degreasing, Abrasive/shot blasting.

1.4.4 **Application of Coating (for test specimen)**
Application of the coating for preparation of the test specimen shall be by airless spray except where the property to be determined is independent of method of application and where the test method calls for panel preparation by some other method.

1.5 QUALITY ASSURANCE

The quality assurance document shall provide following information:-

a) Inspection of surface of substrate; methods and acceptable range of surfaces.

b) Preparatory steps, checks, tests and range of parameters while preparing the coating for application.

c) Methods & procedures for controlling the rate of material deposition on the substrate & thickness of wet film along with methods of inspection & acceptable range of parameters.

d) Procedure, detection of flaws and repairs.

e) Application method and surface preparation requirement for Recoating on an existing coated surface.

1.6 TEST RESULTS:

Test results should be tabulated against the required property values given in para 2.0 of this section and submitted. For pre qualified samples & submitted along with the quotations. The test numbers 19, 20 and 21 could be carried out only at BARC. Supplier has to submit coated panels of nominal dimensions as per section 1.4 (15 panels each) of this specification and get the test done and results to be submitted.

2.0 PRIMER TEST REQUIREMENTS

Sr.No. 1	Test	Method	Required Property Value (Refer PP-M-1729)
1. ** C	Zinc size Zinc shape Zinc purity	 ASTM D 520 ASTM D 521	6 to 9 micron average. Spherical. ➢ 98% Zinc dust conforming to ASTM Type II high purity grade. (see note 1)
2.	Volume solids	IS – 101 ASTM D 2697	> 65 %
3.	Total solids %	ASTM D 2369	> 80% by weight ➢ 84% by weight
4.	Flash point for primer Body and finish	IS 101	> 15 deg. C
5.	Pot life at @ 30 deg. C		> 4 hrs.
6.	Shelf life at @ 30 deg. C		Liquid > 6 months Powder > 12 months
7.	Drying time – B & K recorder	Paint technology manual part V, testing of paints	Surface dry < 3 hrs Hard dry < 18 hrs
8.	Total dry film thickness	ASTM D – 1186 1974	65 – 75 microns per coat Airless spray.
9.	Salt spray	IS 2074 1979 or ASTM B 117 1985	System should pass 1500 hrs exposure without blistering or corrosion.
10.	Mud cracking	S S P C - 20	None at 150 micron thickness under 10 x magnification.
11.	Coverage (M 2/litre) (Theoretical)	IS 101 1964	➢ 8.5 sq.m/lit at 75 micron thickness
12.	Practical Coverage (Plane Surface)		Min. 6.25 sq.mt at 75 micron thickness.
13.	Viscosity (Kinematic) At 25 deg. C in stokes	ASTM D 1200 (see note 2)	3 to 5
14. a) ** C	Practical adhesion by Abrasivewitch pull off technique	ISO 4624 DIN – 9, BS - 3960	> 90 kg/sq cm.
14.b)	Failure in cohesion by Abrasivewich pull off technique	ISO 4624 DIN-9 BS – 396	> 80 %
15.	Abrasion (dry) Resistance (mg/1000 cycle with 1 kg load and CS – 17 wheel	Taber Abraser Federal test method Std. 141 Test method – 6192	, 250 mg

		ASTM D 4060	
16.	Flexibility Test Panel bent on 1. Inch dia cylindrical mandrel	ASTM D 1737- 1979	System should pass free from detachment, crack surface deformation, etc.
17.	Impact resistance direct impact of 10.5 lbs weight falling from 23 inch height, ball 12 mm diameter.	DEF 1050	System should pass free from cracking, detachment, at the peak or periphery of the buldge
18.	Resistance to five different conditions of test as follows a) Distilled water – 4 weeks b) Deionising water – 4 weeks c) Petrol – 4 weeks d) Hot water at 90 deg.C – 30 minutes e) Steam impingement (saturated) at 2 kg/cm2g – 10 minutes.	IS 101-1964 IS 159-1972 ASTM D 1308 1973	System should pass free from defects like blistering, and adhesion.
19. ** C	Radiation resistance	ANSE N 5.12 – 1974	System should have no visible change such as chalking, checking, cracking, blistering, delamination, tackiness.
20. ** C	Dry thermal ageing	NPCIL method (see note 3)	Free from surface blisters, bulging, delamination and detachment from substrate.
21. ** C	Loss of coolant	BARC method	Free from surface blisters, bulging, delamination and detachment from substrate.

** C ---Critical property

Note: 1. Zinc Purity requirements of ASTM-D-520 Type-II Grade

2 Higher viscosity may be permitted if suitable methods such as power stirrer could be employed at the time of application, if the paint could be applied with the airless spray system described in the specification, without any additional accessories.

3. Coated panels are exposed to dry heat of 110 deg.C for a period of 49 days in a thermal chamber. The performance of coating shall be observed for its required property.

SECTION-4

1.0 Color Code in Nuclear Power Plants

The Pressurised Heavy Water Reactors has large number of systems/sub systems and equipments for its safe operation. This has resulted in dense layout of piping, valves, equipment, cable trays etc. specially inside the Reactor building. The chances of operating wrong valve in wrong system increase directly with the number of systems and equipments. This can be averted to a large extent by proper identification of services, process lines and equipments using distinct colors and appropriate letters etc.

This specification provides a system of colour coding and lettering for identification of major piping and equipment in the plant. Also included here are the guidance for choosing the type of coating and their critical properties to ensure safety of the plant.

As the operating staff of Nuclear Power Plant is normally drawn from the one's which are already operating. With respect to existing operating plants, the colour codes have been kept identical except for minor changes in Electrical system. However, there is a need for standardized, well established 'Piping and Equipment Identification Code' which should be uniformly followed for all Nuclear Power Plants.

It is to be mentioned here that Atomic Energy (Factories) Rule 61 'Colour Coding of Service Lines' recommends IS-2379-1963 and IS-5-1978.

The philosophy of IS-2379 has been adopted in this specification on a broad basis except for certain services. Wherever colour shades (numbering) have been mentioned it is in accordance with IS-5-1978.

IS-2379 also provides flexibility and discretion for Industrial Establishments where a specific colour code system exists. In case of Nuclear Power Plants, we have been following a particular colour code scheme right from the beginning.

Thus, there is a need for a standardized, well established 'Piping and Equipment Identification Code'.

2.0 APPLICABLE SPECIFICATIONS:

This specification draws guide lines from the following specifications.

1) Letter No. DAE: I-16 B(1)4246 dt.17.8.59/ 13.11.59
2) RAPP-3 & 4 Norms for piping identification (RN-2)
3) MAPS Norms for piping identification (MN-2)
4) NAPS Norms for Piping identification (NN-2)
5) Kaiga Station Norms for Piping Identification
6) Indian Gas Cylinder Rules 1940
7) PB-S-5041(Procurement Document electrical Group)
8) IS-5--1978---For colour Shades.

3.0 ADVANTAGES OF THE CODES FOR IDENTIFICATION:

3.1 It brings in awareness to the following types of hazards.

a) Radiation hazards
b) High temperature hazards
c) Electrical hazards
d) Fire hazards

3.2 In Pressurized Heavy Water type of power reactors, expensive fluids e.g. Heavy Water and Helium are used. Absence of proper identification can lead to spillage and/ or losses due to operational errors.

3.3 Certain process lines may contain high temperature, high pressure fluids. Mal operation of these systems can be highly dangerous resulting in flash burns in case of leaks. It is equally harmful when a system under high vacuum is operated wrongly. Similarly, a spillage of radioactive substance due to mal operation of a valve may lead to avoidable man-rem consumption in the plant. These can be averted by proper identification.

3.4 It is helpful in the commissioning and normal routine operation of systems, if the equipment and direction of flow etc. are properly identified.

3.5 Certain safety systems like fire fighting water system etc. are meant for plant personnel protection during emergencies. These should not be isolated (disabled) without realizing the consequences. Proper identification can caution the operator that he is operating on an emergency system.

3.6 It is desirable to identify the electrical conduits from the process lines. This reduces electrical hazards. It is helpful in understanding the electrical distribution of a standardised representation is followed in graphic bus mimics. This would enable to identify the voltages and the type and classes of power.

4.0 COLOUR SCHEDULE AND COLOUR CODING AND LABELLING

4.1 Equipment codes

The colour coding to be followed for machinery, fire fighting equipment, electrical equipment etc. given in the para 6.0 of this Section. Further colour coding to indicate high temperature, radioactivity etc. and other legends for those equipment are given in para 4.6, 4.7, 4.8 of this document. The numbers in parentheses following the colours mentioned are the shade numbers included in IS-5, 1978 “Colours for ready mixed paints”. In case aluminum paint is specified for coding and the equipment piping is already clad with aluminum sheets, no further painting is required.

4.2 **Piping Code**

This can be broadly split into two sections.

4.2.1 **Colour Code**

The system of colour coding consists of a ground colour and one more colour band super imposed on it. The ground colour is generally kept same for particular group of fluid for example water, steam, oil, chemicals etc. Further identification is achieved by means of applying one or more colour bands which varies from one fluid to another fluid.

The colour code indicates the nature of the fluids contained in the system and also suggests its physical qualities such as temperature, pressure and radioactivity etc.

4.2.1.1 **Label / Marking**

- Size of Arrows Shows in Fig. (1)
- Positioning of Markings for Visibility Shows in Fig. (2)
- Colour Band Superimposed on ground colour Shows in Fig. (3)
- Hazard Marking Shows in Fig.(4)
- Colour Code for Radioactivity Shows in Fig. (5)
- Labelling Shows in Fig. (6)
- Flow Direction Shows in Fig. (7)

4.2.2 **Additional Identification Code**

The additional identification code covers following requirements.

4.2.2.1 Indications of direction of flow by an arrow: Where direction of flow is to be indicated, arrows may be painted near valves, junctions, walls etc. at a suitable interval along the pipe in a manner best suited to local conditions, refer fig (7) If a label or badge with codified indication is attached to the pipe, the direction of the flow may be indicated by the pointed of label/badge. The size of the arrow shall be as per fig (1).

4.2.2.2 Indications of the equipment from which flow started and of the equipment Where it is led to, using English language.

4.2.2.3.1 Identification of the actual system i.e. two or more independent systems containing the same fluid will be additionally identified by the USI number.

4.2.2.4 **Visibility of Markings**:
Where the pipe lines are located above the normal level of vision of the operator, the lettering shall be placed below the horizontal line of the pipe refer fig(2)

4.3 **Colour code details:**

4.3.1 The colour codes for Piping/Electrical Systems the para 7.0 of this Section of this document
The colour codes to be used for Piping/Ducting/Electrical etc. are broadly classified in following groups

i) Water and Steam systems
ii) Gas systems
iii) Oil systems
iv) Chemical systems &
v) Electrical systems.

4.3.2 Colour codes for gas cylinders are given in the para 10.0 of this Section..

4.4 **High pressure and low pressure labels**

High and low pressure systems shall be identified by providing 'HP' and 'LP' labels respectively. For air systems moist and dry air shall be labeled by 'M' and 'D' respectively. These labels should be put where the lines join or leave equipments, headers, EPs etc. and also at appropriate locations throughout the piping run. A label shall generally be in white against the background of black. Black background should extend at least twice the dimension of letter lengthwise and about the same dimension as the letter across the piping. Attention should be given to the visibility of the lettering from working platforms. For example, where the pipelines are located above the normal line of vision of the operator, the lettering should be placed below the horizontal line of the pipelines.

4.5 **Letter Size**

The recommended size of lettering for pipes of different diameters is given below:

Pipe OD or Covering Dia. "mm"	Size of Legend " mm"
20 to 30	10
30 to 50	20
50 to 80	30
80 to 150	40
150 to 250	63
Above 250	90

4.6 **Colour Code for high temperature**

All process line which contain high temperature >60°C, fluids shall have Signal Red (537) bands located at suitable intervals including their location at suitable intervals including their location of origin and termination, superimposed on the ground colour, specified for the particular line.

4.7 **Colour code for Radioactivity**

System handling radioactive fluids shall have a band consisting of a magenta Crimson (540) colour strip in the middle flanked by yellow strips

on either side superimposed on the ground colour of the pipe/duct. The width of all the strips should be equal. The band should be placed at suitable intervals including the points of origin and termination of the piping/duct.

4.8 **Other Legends**

All lines shall have process line nomenclature (as shown on the flow sheet) painted in white on a black background. The sequence of legends shall be as follows:

Line size –Fluid-USI-Line number

For clarity of reading, line size and USI may be written in lemon yellow (355) while the fluid and line number in white. This should be preceded by a label showing the originating / terminating equipment separated by arrows indicating the direction of flow. The tip of the arrow should be in lemon (355) while the rest could be in white against a black background. The margins to be provided in extension of background beyond the legends and the size of lettering shall be as per para 3.2.2 of this document. Such legends shall be repeated along the entire run of the pipe or duct at distances best suited to the local conditions.

4.9 **Size and spacing of bands**

When coding a line with bands of different colours, the bands shall be painted where the line leaves or enters a wall, ceiling or floor, join and leaves an equipment, branches out or into other piping refer fig(3). The bands shall be 50mm (nominal) wide, even appearance well spaced, where practicable, approximately 200 mm away from a wall, ceiling, floor, equipments, valve etc. Where double bands are used, the bands are to be separated by a space of 25mm (nominal) expecting the case where one band forms the border for other such as in the case of band for radioactivity . The distance between repeated bands shall be not less that 500 mm and not exceeding 5000 mm .The spacing shall generally be decided best suited to the local conditions. In the event, the ground colour is not continuous throughout the piping run the minimum span of ground colour shall be 300 mm at each location with the bands painted in the middle.. This is to avoid the ground colour being mistaken for a band.

4.10 **Stainless Steel, Aluminium Pipes, Valves, Miscellaneous**

Stainless steel and aluminium pipes shall be painted with bands of colours only. A breakable pipeline shall have a band painted lengthwise so that removal/refit does not alter the shape of the bands.

Valve body shall be painted with ground colour for the piping to which it is connected but the spindle wheel shall be painted with the colour of the identifying band. In case there are two identifying bands for the piping, the ground colour for the valve spindle wheel shall be the colour of the primary bands indicating the type of fluid with further equally spaced

bands of the second band colour identifying the radioactivity, temperature or such condition of the fluid. Coatings which contain halogens shall not be used on stainless steel piping or equipment.

5 TYPE OF PAINT , SURFACE PREPARATION ETC.

5.1 Paints used for colour coding

Paints used for ground colours shall be selected and their method of application shall be specified consistent with the requirement of paint for that particular equipment, system and area. For example, the paints used for colour coding the piping, equipment etc. in the Reactor Building should be radiation resistant, de-contaminable, resistance to hot water spray and submersion as well as steam impingement & submersion. The required tolerance of the paint may again vary from area to area i.e. the paint specifications for colour coding in moderator room area may differ from pump room area. Reference should be made to the paint specifications for the respective area for procuring paint for colour coding so as to ensure that a film does not dislodge from substrate and tend to preclude operation of an engineered safety feature during or following an accident. Selection of generic type of paint and the thickness of the coating should be decided such that fire hazards due to combustion of the dry paint film is kept minimum. In case a paint of suitable generic type and quality is not available in required ground colour, qualified paint of nearest colour shall be used over coated with a mist coat of compatible generic coating of required shade. Compatibility of coatings shall be ensured for painting bands on the ground colour. Wherever Epoxy coatings are to be used refer Section-2

5.2 Surface Preparation

Surface preparation shall be consistent with type of paint used, thickness of coating and environment seen by coating.
Generally powered hard brush shall be used for surface cleaning to the extent that no sign of rust or scale is visible on the pipe or equipment. The primer coating shall be applied immediately following this after removal of all loose debris present due to former operation as well as removal of all oil grease etc, if any, on the substance.

6.0 **Colour Coding for Equipment and Machinery**

Equipment / Machinery	Colour
(A) Sprinkler pipe/ Fire fighting equipment	Signal Red (537)
(B) Overhead mobile equipment such as	
Cranes	Light Orange (557)
Hooks	-do-
Chain hoist	-do-
Conveyors etc.	-do-
Automatic trucks	Light Orange (557)
Machinery (Except workshop machinery)	-do-
Moving parts	-do-
Exposed parts of gears	-do-
Control handles and Levers	-do-
Tripping hazards such as floor	-do-
Elevation changes, pit edges etc.	-do-
(C) Workshop machinery except cutting edges, moving parts, control levers as described in (B) above	Aircraft grey (693)
(D) Steel Structures	Eau-de-Nil (216)
(E) Railings : Top	Black
Rest	Eau-de-Nil (216)
(F) Tanks	Aircraft grey (693)
Heat Exchangers	--do--
Turbine Generator	--do--
M.G. Sets	--do--
Diesel Generator	--do--
Transformers	--do--
Electrical panels	--do--
Switches	--do--
Fans	--do--
Blowers	--do--
Compressors	--do--
Pumps	--do--
Motors	--do--
Equipment Supports	--do--
Switch gear	--do--
Insulation cover for insulated Equipment	--do--
(G) First aid equipment and the points at which It is dispersed.	Green (221)

7.0 Colour Coding for Piping System & Electrical System

S.No.	Piping	Ground Colour	Colour of bands
(A)	Water and steam system Heavy water (See Note-1) Ordinary water/ River water (see note-5)	Dark Violet (796) Grass Green (218)	
	Domestic/ Drinking water	Grass Green (218)	French Blue (166)
	Domestic hot water	Grass Green (218)	Signal Red (537)
	Chilled /Ice water	Grass Green (218)	White
	De-mineralised water (see note-2)	French blue (166)	
	Active Process water (see note-2)	French blue (166)	
	Condensate water	Sky blue (101)	
	Boiler feed water	Sky blue (101)	Post Office Red (538)
	Reheater return	Sky blue (101)	Post Office Red (538)
	Steam	Aluminium	Post Office Red (538)
	Steam to Bypass condenser	Aluminium	Post Office Red (538)
	Drainage -active	Black	Appropriate band depending on temperature and radioactivity with magenta bands.
	Drainage inactive	Black	No bands
	Stand by water	Signal Red (537)	
	Fire Fighting water	Signal Red (537)	
	Sea water	Oriental Blue (174)	White
	Sludge Disposal lines form clarifloculators	Black	
(B)	**Gas System**		
	Compressed air		
	a) Mask air	White	Two state bands (634)
	b) Instrument air	White	No bands
	c) Service air	White	One state bands (634)
	Helium	White	Apple Green (281)
	Hydrogen	White	Signal Red (537)
	Nitrogen	White	Lemon (355)
	Carbon dioxide	White	Golden Brown (414)
	Argon	White	Oriental Blue (174)
	Vacuum	White	Black
	Chlorine	White	Aircraft Grey (693)
	Oxygen		Black & white bands only
	Off gas (condenser)	White	Single yellow band

			(309)
	Ventilation Systems		
	Inlet	Silvery Grey (628)	
	Exhaust & Vent lines	Salmon Pink (443)	
	Air cooling Circuits	Silver Grey (628)	
	Vapor Recovery	Silver Grey (628)	
	Pyrofax	White	Magenta Light Orange (557)
	Note : Moist and dry air systems shall be indicated by M and D in capital letters respectively at appropriate places		
(D)	Oil Systems		
	High speed diesel oil	Light Brown (410)	
	Turbine oils (4130)	Light Brown (410)	Lemon (355)
	Insulating oil	Light Brown (410)	Black
	Hydraulic Power oil (Relay Oil)	Light Brown (410)	White
	Other lubricating Oils	Light Brown (410)	French Blue (166)
	Chemical Systems		
	Acids (See Note-3)	Light purple brown (449)	
	Alkalis (see Note-4)	Light salmon pink (442)	White
	Boiler water conditioning chemicals (see note-6)	Light salmon pink (442)	Black & sky blue (101)
	Chemical Waste	Light salmon pink (442)	Black
	Liquid Chlorine	Yellow(309)	Aircraft grey (693)
(E)	Electrical Systems		
	Electrical Conducts	Terra Cotta (444)	Green bands(218)
	Fire Alarm	Terra Cotta (444)	Orange (557)
	P.A. & Communication	Terra Cotta (444)	
	Panels, Switches and transformers	Aircrafts grey (693)	
	Bus Mini colour codes		
	400 KV	Red(536)	
	220 KV	Light Orange(557)	
	21 KV	Olive Green(220)	
	6.6 KV-cl IV	Aircraft blue(108)	
	6.6 KV –cl III	Pink(443)	
	415 V Class IV	Dark Blue (104)	
	415 V Class III	Violet(796)	
	415 V Class II	Yellow	
	250 V DC	Black	
	Main Generator	Black Disc with AC symbol	
	Diesel Generator	French Blue (166) disc with AC symbol	
	MG Sets	Half lemon (355), half white discs	
	Power Cable Pan Div I	1 band of Red paint	
	Power Cable Pan Div II	2 bands Red paint	

	INC Cable Pan – A/D	Blue colour 1 bands	
	INC Cable Pan – B/E	Blue colour 2 bands	
	INC Cable Pan –C/F	Blue colour 2 bands	
	INC Cable Pan – G	Yellow colour 1 bands	
	INC Cable Pan – H	Yellow colour 2 bands	
	INC Cable Pan – J	Yellow colour 3 bands	
	INC Emergency lightly Fixtures	Red band	
	Transformer	Zig-zag pieces with appropriate voltage colour code as described above	

Notes:

1) Dark Violet (796) will be used for reactivity mechanism cooling circuits (3130), Moderator (3200), Cleanup (3492), D2O upgrading (3493), Moderator liquid poison (3480), Heavy Water sampling (3490), Fuelling machine auxiliaries (3525)

2) APW line should have additional bond of bright cirmson (540) colour. This colour will be used for following system.

   (a) 7131 - Active LP Process water cooling system

   (b) 7133 - Active HPPW cooling system

   Active process water line should have additional band of Magenta & Yellow as described elsewhere in this document.

3) In general the acid used is sulphuric acid or hydrochloric acid.

4) In general alkali used is sodium hydroxide or potassium hydroxide.

5) Grass Green (218) colour will be used for the following System.

USI	Description
7112	Plant water supply system
7120	Condenser circulating water system
7125	APW cooling water system
7132	Non active LP Process water system
7134	Non active HP Process water system

6) This includes hydrazene, morpholine and phosphate, if any:

7) Equivalent colour codes of various reputed manufacturers are given in the para 8.0 and 9.0 of this Section it is done to identify the market availability of various colours per their codes.

8.0 **Equivalent colour codes for piping identification**

Piping	**Ground colour**				**Colour of bands**			
	Original IS-5	**Equivalent available**			**Original IS-5**	**Equivalent available**		
		Shalimar	**Berger**	**Asian**		**Shalimar**	**Berger**	**Asian**
Water /steam/ Heavy Water system	Dark Voilet 796			Wild purple 718-2				
Ordinary Water/River Water (see note-5)	Grass green 218	**Jade Green 238**	New Jade Green 257	Jade Green 224-4				
Domestic Drinking water	Green grass 218	**-do-**	-do-	-do-	French blue 166	French blue 166		French blue 112-4
Domestic hot water	Grass green 218	**-do-**	-do-	-do-	Signal red 537	Signal red 537	Signal red 533	Signal red 520-2
Chilled / Ice water	Grass green 218	**-do-**	-do-	-do-	White			
Demineralised water	French blue 166	French blue166		French blue 112-4	Crimson 540			Imp crimson 510-1
Active process water	French blue 166	**-do-**		-do-				
Condensate water	Sky Blue (101)	Sky Blue (125)	Sky Blue (134)	Sky Blue (125-4)				
Boiler feed water	Sky Blue (101)	-do-	-do-	-do-	Post Office Red (538)	Post Office Red (538)	Post Office Red (538)	Post Office Red (578-2)
Reheater steam	Sky Blue (101)	Sky Blue (125)	Sky Blue (134)	Sky Blue (125-4)	Post Office Red (538)	Post Office Red (538)	Post Office Red (538)	Post Office Red (518-2)
Steam	Aluminum				-do-	-do-	-do-	-do-
Steam to bypass condenser	-do-				-do-	-do-	-do-	-do-
Drainage a) Inactive b) Potentially Active c) Active Chemical	 Black Black Black				 No band Single White band Double White Band			
Stand by water / fire fighting water	Signal red 537							
Gas System Compressed Air a)Mask air b)Instrument air c)Service air	 White White White				 Two slate Bands. 634 No bands One slate Band (634)			601-4 Ad. Grey
Helium	White				Apple green 281	Apple green 281	Opaline green 208	Opaline green 231-4
Hydrogen	White				Signal red 537	Signal red 537	Signal red 533	Signal red 520-2
Nitrogen	White				Lemon 355	Lemon	Lemon	Lemon

Piping	**Ground colour**				**Colour of bands**			
	Original IS-5	**Equivalent available**			**Original IS-5**	**Equivalent available**		
		Shalimar	**Berger**	**Asian**		**Shalimar**	**Berger**	**Asian**
						yellow 305	yellow 334	yellow 317-3
Carbon dioxide	White				Golden brown 414	Golden brown 414	Golden brown 432	Golden brown 413-4
Argon	White				Oriental blue 174	Nilgiri blue 148		Light blue 113-4
Vacuum	White				Black			
Oxygen					Black &white Bands only			
Off gas (condenser)	White				Signal yellow 309 (canary yellow)			Canary yellow 306-3
Ventilation Inlet	Silver grey 628	Light grey 632	Light grey 606	Light grey 608-4				
Exhaust & vent lines	Salmon pink 443	Rosemary pink 435		Dawn 469-4				
Air cooling circuits	Silver grey 628	Light grey 631	Light grey 606	Light grey 608-4				
Vapour recovery	Silver grey 628	Light grey 631	Light grey 606	Light grey 608-4	Crimson 540	Cherry red 525	Cherry red 416	Imp crimson 510-1
Pyrofax	White				Light orange 557	Dawn glow 558	Tata Dawn glow 525	Dawn glow 526-4
Oil system								
High speed diesel oil	Light brown 410	Golden brown 414	Golden brown 432	Golden brown 413-4				
Turbine oil	Light brown 410	-do-	-do-	-do-	Lemon 355	Lemon yellow 305	Lemon yellow 334	Lemon yellow 317-3
Insulating oil	Light brown 410	-do-	-do-	-do-	Black			
	Light brown 410	-do-	-do-	-do-	White			
Other Lubricating oil	Light brown 410	-do-	-do-	-do-	French blue 166	French blue 166		French blue 112-4
Chemical systems								
Acids (see note-3)	Light purple brown(449)	Golden yellow 306	Golden yellow 306	Golden yellow 313-3				
Alkali (see note-4)	Light salman pink 442	Rosemary Pink 435		Candy 478-2				
Boiler water conditioning chemicals (see note-6)	Light salmon pink(442)	Lemon yellow 305	Lemon yellow 334	Lemon Yellow 317-3	Black & sky Blue 101	Black & sky blue 125	Black & gray blue	Black & sky blue 125-4
Chemical waste	--do--		-do-	-do-	Black			
Liquid chlorine	Yellow 309 (canary yellow)			Canary yellow 305-3				

9.0 **Equivalent Colour Codes for Electrical System Identification**

Piping	**Ground colour**				**Colour of bands**			
	Original IS-5	**Equivalent available**			**Original IS-5**	**Equivalent available**		
		Shalimar	**Berger**	**Asian**		**Shalimar**	**Berger**	**Asian**
Electrical systems								
Electrical conduits	Terra cotta 444	**Leaf Brown 469**	Leaf Brown 437	Leaf Brown 415-4				
Electrical panels switch & transformer	Aircraft grey 693	Light grey 631	Light grey 606	Light grey 608-4				
Bus mimics colour codes								
230 KV systems	Post office Red 538	Post office Red 538	Post office Red 561	Post office Red 518-2				
16 KV systems	International Orange 592	Spl. Deep Orange 506	Deep Orange 530	Deep Orange 506-2				
6.6 KV systems	Air craft blue(108)	Apple Green 201	Eau-de-nil 210	Water Green 246-4				
415V Class –IV Systems	Dark blue (104)	French Blue 166		French Blue 112-4				
415-Class-III Systems	Violet (796)	New phrozi 121		Light Blue 112-4	Black			
415V Class-II	Yellow (309)	Lemon Yellow 305	Lemon Yellow 334	Lemon Yellow 317-3				
250 V DC	Black							
Main generator	Black Disc with AC symbol							
Diesel Generator	French Blue 166	French Blue 166			French white	*	*	
	* (French Blue Disc with Half white discs)							
Transformer Zig-Zag pieces with appropriate voltage colour code as described above:								

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10.0 Colour Code for Gas Cylinders

Gas Cylinder Colour Code

The colour code recommended for gas cylinders is based on the Indian Standard Identification Colours for gas cylinders excluding for medical purpose extracted form Indian Gas Cylinders rules 1940.

	Gas	Ground Colour of Cylinder		Colour of Neck bands	
Sl. No.	Name	Symbol	Nominal	Indian Standard Colour No.	Nominal
1.	Acetylene	C2H2	Maroon	541	None
2.	Argon	A	Blue	103	None
3.	Carbon-dioxide for tropical& marine use	C02	Black		White or Aluminium Paint
4.	Chlorine	C1	Yellow	356	None
5.	Freon (Dichloro-diflouro methane)	CC12F2	Patri coloured bottom end grey neck end mauve(grey)	630	-
6.	Helium	He	Brown	411	None
7.	Hydrogen	H	Red	537	None
8.	Nitrogen	N	Grey	630	Black
9.	Oxygen	O	Black	-	None

Note: i) The neck band shall occupy only half the portion of the cylinder between Junction of the hemispherical and cylindrical portion and the neck.

ii) Equivalent colour codes of various reputed manufacturers as given in para 11.0 of this Section. It is done to identify the market availability of various colours per their codes.

11.0 Equivalent colour codes for Gas Cylinders Identification

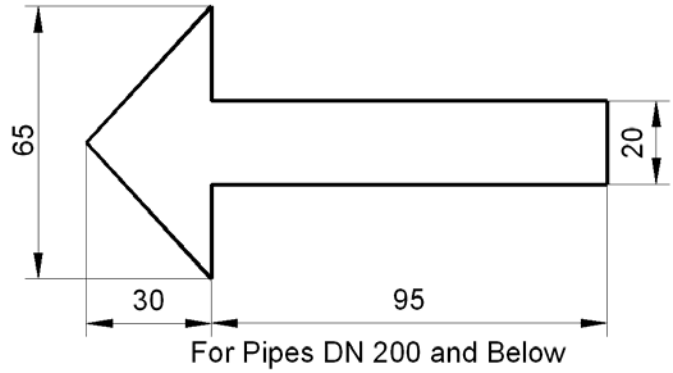
Piping	**Symbol**	**Ground colour**				**Colour of bands**			
		Original IS-5	**Equivalent available**			**Original IS-5**	**Equivalent available**		
			Shalimar	**Berger**	**Asian**		**Shalimar**	**Berger**	**Asian**
1. Acetylene	C_2H_2	Maroon 541			Mercedes Red 514-4	None			
2. Argon	A	Blue 103 (Peacock Blue)			Light Blue 113-4	None			
3. Carbon dioxide	CO_2	Black				White or Aluminium paint			
4. Chlorine	Cl_2	Yellow – 356 Golden yellow	Golden yellow 306	Golden yellow 306	Golden yellow 313-3	None			
5. Freon	CCl_2F_2	Patri coloured Bottom end Grey & neck mauve (Grey)							
6. Helium	He	Brown-411 Middle Brown	Leaf brown 469	Leaf brown 437	Leaf brown 415-4	None			
7. Hydrogen	H	Red 537 signal Red	Signal red 537	Signal red 533	Signal red	None			
8. Nitrogen	N	Grey 630 (French grey)	Light grey 631	Light grey 606	Light grey 608-4	Break			
9. Oxygen	O	Black				None			

12.0 AERB code of Practice for design of PHWR based Nuclear Power Plants.

Coverings & Coatings**:**

Section 0710 draft of AERB code of practice for design of PHWR based Nuclear Power Plants.

'The coverings & coatings for components and structures within the containment system shall be selected and then methods of application shall be specified, to ensure fulfillment of their safety functions and to minimise interference with other safety functions in the event of deterioration.'



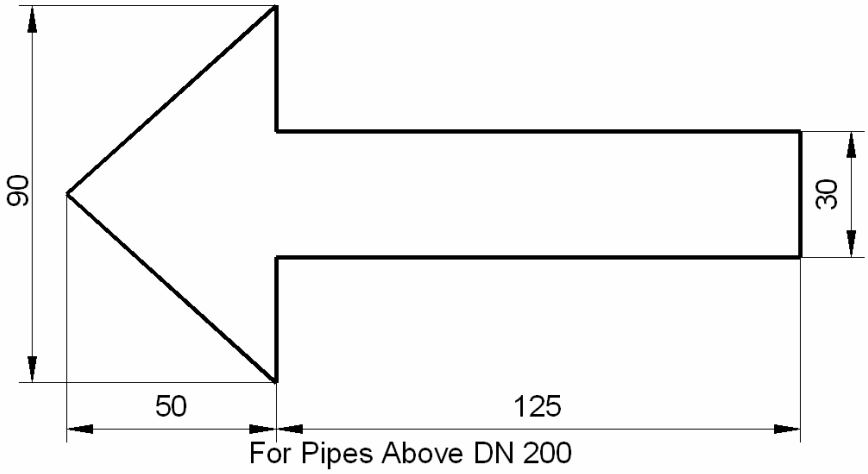


Fig.(1) SIZE OF ARROWS

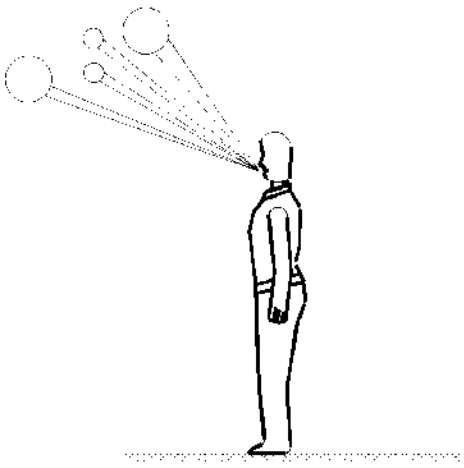
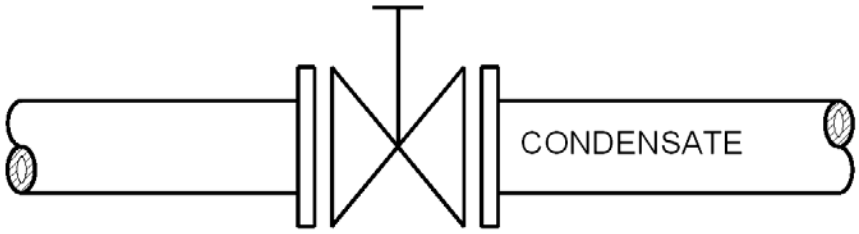
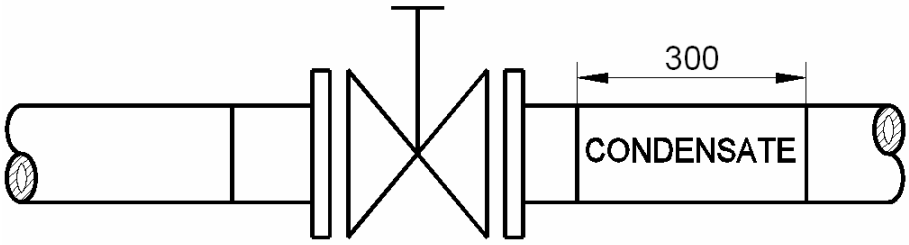


Fig.(2) POSITIONING OF MARKINGS FOR VISIBILITY



A. GROUND COLOUR-APPLIED TO FULL SECTION



B. GROUND COLOUR-APPLIED TO A PORTION ONLY

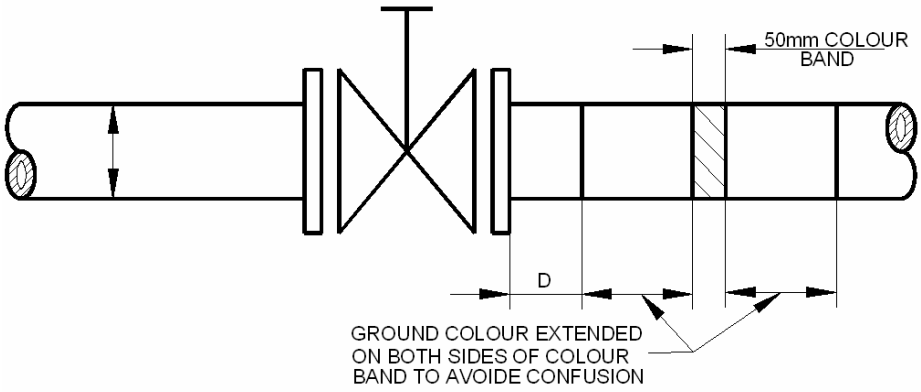
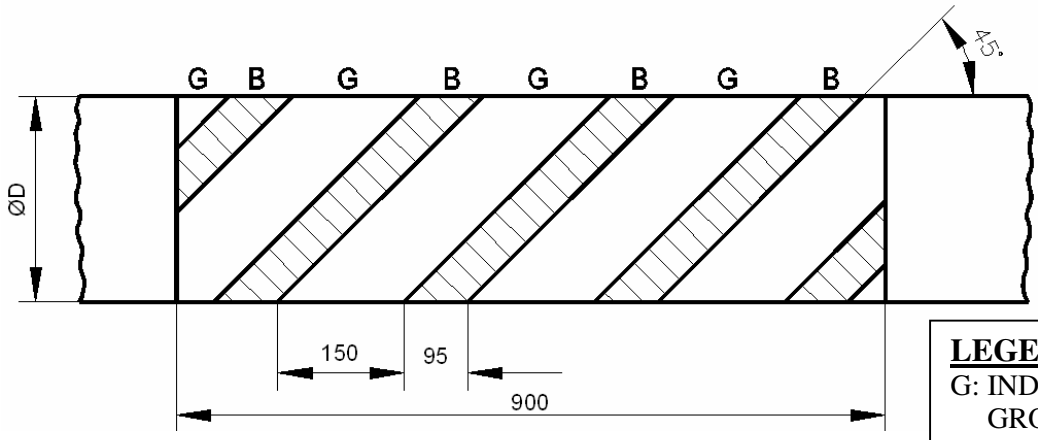
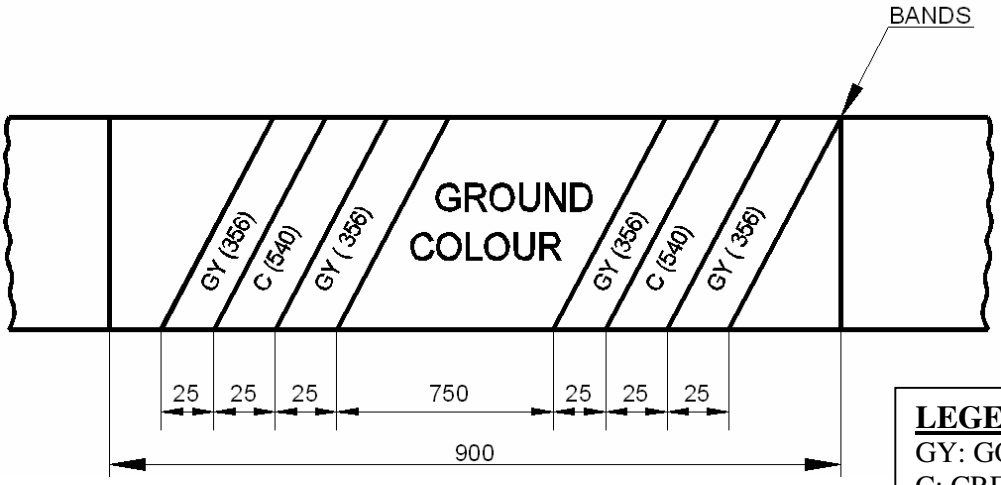


Fig.(3) COLOUR BAND SUPERIMPOSED ON GROUND COLOUR



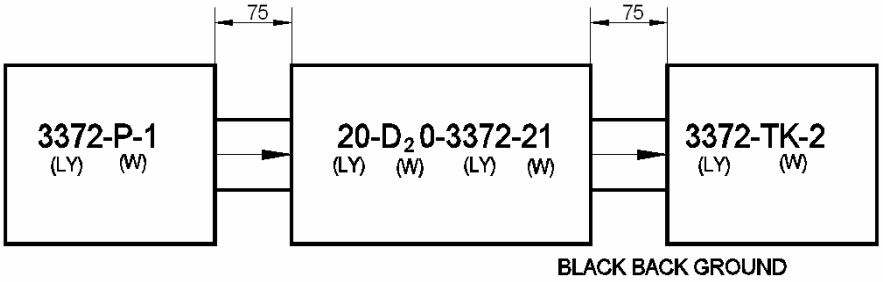
LEGEND
G: INDICATES GROUND COLOUR
B: INDICATES COLOUR OF BAND

Fig.(4) HAZARD MARKING



LEGEND
GY: GOLDEN YELLOW
C: CREMSON/MAGE NUMBER IN PARA INDICATE THE COLOUR

Fig.(5) COLOUR CODE FOR RADIOACTIVITY



LEGEND
LY: LEMON YELLOW
W : WHITE BACK GROUND

Fig.(6) LABELLING

Fig.(7) FLOW DIRECTION

SECTION-5

Technical Specn for Two Component High Build Solvent free Polyurethane Coating on Metal Surfaces

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1.0 SCOPE OF SPECIFICATION

This specification covers the general requirements of coating materials, coating application, inspection, testing, repair and handling aspects associated with the coating of metal surfaces using two component, high build, solvent free, 100% Solid, Polyurethane (Tar free) coating, specially for outdoor equipment and piping.

2.0 CODES AND STANDARDS

This work shall conform to the following documents latest revision as on NIT Date.

NACE No.1/ SSPC–SP-5	-	White Metal Blast Cleaning.
NACE-RPO 175	-	Standard Recommended Practice for Control of Internal Corrosion in Steel Pipelines and Piping System.
ASTM-G 12	-	Test Method for Non-Destructive Measurement of Film Thickness of Pipeline Coatings on Steel.
ASTM-D 1186	-	Test method for nondestructive measurement of dry film thickness of non conductive coating applied to a ferrous base.
ASTM – G 8	-	Test Method for Cathodic disbonding of Pipe Line Coatings.
ASTM - G 95	-	Test Method for cathodic disbondment test of pipeline coatings (Attached cell method)
ASTM – G 14	-	Test Method for Impact Resistance of Pipe Line Coatings.
ASTM-D 2794	-	Test method for resistance of Organic coatings to the effect of Rapid Deformation (Impact)
ASTM – G 62	-	Test Methods for Holiday Detection in Pipeline Coatings.
ASTM – G 154	-	Practice for Operating fluorescent Light Separator for UV Exposure of Non Metallic Materials.
ASTM – D 638	-	Test Method for Tensile Properties of Plastics.
ASTM-D 412	-	Test method for vulcanized rubber and

		thermoplastics and thermoplastic Elastomers-Tension
ASTM – D 4060	-	Test Method for Abrasion Resistance of Organic Coatings by the Taber abraser.
ASTM – F 1249	-	Test Methods for Water Vapor Transmission rate through plastic film and sheeting using a modulated Infrared sensor.
ASTM – D 1653	-	Test Methods for Water Vapor Transmission of Organic Coating Films (Cap Method).
AST – D 2697	-	Test Method for Volume Non Volatile Matter in Clear or Pigmented Coatings.
ASTM – D 4541	-	Test Method for Pull of Strength of Coating using Portable Adhesion Testers.
ASTM – D 522	-	Test Method for mandrel bend test of attached organic coatings.
ASTM – D 543	-	Test Method for Resistance of Plastics to Chemical Reagents.
ASTM-D-2240	-	Test Method for Rubber Property – Durometer Hardness.

3.0 MATERIAL SPECIFICATION

3.1 Coating Materials

3.1.1 The coating material shall be of two component, solvent free, high build 100% solid, Polyurethane (Tar free) having properties as indicated in Annexure-1.

3.1.2 The coating material shall be suitable for internal and external lining of carbon steel and stainless steel pipe lines, tanks/vessels, equipment like pumps valves and structural components.

3.1.3 The coating material shall provide internal fluid corrosion protection of metal surfaces for 2 to 4 m/sec. flow velocity condition, intermittent stagnation and also provide high abrasion and erosion resistance.

3.1.4 The coating material shall provide external fluid corrosion protection of metal surfaces if coated for full immersion or partial immersion in fluid and also highly corrosive environment on pipe lines, structures & equipment.

3.1.5 The maximum / minimum temperature of fluid in contact with coating is 60 ^{o}C / 20 ^{o}C and outside environment maximum / minimum temperature is 45 ^{O}C / 10 ^{o}C.

3.1.6 The plant is designed for 50 years of life, so the coating material shall give design life of at least 25 years without any major damage to material due to loss of coating.

3.2 **Primer**

Primer (if required) shall be compatible with main PU coating. Primer material should have high bonding properties for base metal and main coating material. Desired thickness shall be achievable by single coat with airless spray guns.

3.3 **Blasting Material**

Material for blast cleaning shall be of copper slag for CS material and aluminium slag / glass beads for SS material and free from carbonate and chlorides. Slag shall have a particles size which will produce a clean angular surface profile as specified in Paragraph 6.10 of this specification. The abrasive shall be stored in a dry condition and maintained dry during use.

3.4 **Coating Thickness**

3.4.2 Total dry film thickness (DFT) to be achieved with primer coat and main protective PU coat for Internal coating and External coating shall be as per Data sheet enclosed in tender specification. When internal coating is specified in pipe lines, pipe flange face shall be provided with minimum 500 microns (DFT) PU coating thickness(unless other wise specified in tender specification).

3.4.3 If Primer is required, its thickness shall not exceed 100 microns. To achieve required coating DFT, balance thickness to be achieved by Main PU coating.

3.4.4 Total DFT of protective coat to be achieved by not more than three coats.

3.5 Coating Color: - For Internal coating: - Near white or M/F standard. For External coating: - Grass Green (Shade No. 218 As per IS-5) or as per tender specification data sheet.

4 GENERAL REQUIREMENTS

4.1 The coating material should have been used for Petro-chemical refineries, oil fields, on shore or off shore marine environment in at least 2 separate installations for a period of at least 5 years. Any new material to be used shall be with the approval of NPCIL.

4.2 The test reports conducted by reputed test agencies evidencing that materials conform to minimum performance requirements shall be provided. The certificates from coating manufacturer shall be submitted as under.

- That the materials (with batch numbers, dates of manufacture and shelf life) are free from all manufacturing defects.
- That the materials will meet performance criteria as given below when applied.

4.3 Applied coating will be tested for dry film thickness and holidays.

4.4 All coating operations shall be performed under the supervision of and performed by personnel skilled in the application of the coating system.

4.5 All cleaning, priming and coating machines shall be equipped with rubber or wheels overlaid with hard fiber to prevent damaging the metal surface.

4.6 The materials shall be applied by Airless Spray System, as per the standards specified by the material manufacturer.

4.7 The coating application shall be carried out with following machinery as appropriate for internal / external coating –

(a) Portable pipe internal blasting machine (PIBM).

(b) Portable pipe external blasting machine (PEBM).

(c) Portable external blasting machine for structures and equipment.

(d) Portable pipe internal coating machine (PIM) for small bore pipe line coating.

(e) Oil free compressors.

(f) Coating spray guns.

(g) Blower.

(h) Vacuum generator.

(i) Humidity & temperature controlling system for environment.

(j) Surface roughness, DFT measuring instruments (Portable).

(k) Holiday testing machinery (Portable).

5 COATING METHODLOGY

5.1 Shop Coating (Site Facility) / Works

- Receiving and handling of pipeline & equipment at his reception yard.
- Movement of pipes, vessels & equipment through his blasting cleaning and painting facilities.
- Inspection of pipes for visual signs of any raw / blemish that renders item unsuitable for lining.
- Inspection and recording data on every pipe, vessels & equipment with respect to anchor profile, depth of profile and surface cleanliness.
- Surface cleanliness operations.
- Coating.
- Inspection of coating.
- Transfer of mill identification (heat nos.).

5.2 Field Coating of Pipeline Sections (if applicable)

- Determining the maximum length of pipeline that can be practically field coated using his proposed system.
- Cleaning of the internal/external pipe surface by abrasive blasting.
- Removal of all blast medium and other debris from the pipe internals by vacuum
- Inspection of field welds to ensure that they are suitably profiled for coating.

- Inspection of pipe wall for visual signs of any flaw/blemish that might render the pipe unsuitable for coating.
- Inspection of coated pipe.
- Maintaining Inspection records.

5.3 **Field Joint Coating**

This work shall include the following operations including, but not limited to

- Locally blast cleaning the field joint area.
- Removing all debris and inspection of weld profile to ensure suitability for coating.
- Checking pipe anchor profile in field joint area.
- Providing all necessary matting or other barrier material that will be required to protect the line coating from personnel and equipment entering the pipe for field jointing purposes.
- Preparation of pipeline coating edges to receive field joint coating.
- Application of field joint coating.
- Final integrity check of complete coating.

6 SURFACE PREPARATION

6.1 Each component (pipe, fittings, vessel etc.) to be coated shall be inspected and any damage to the item or its beveled ends shall be recorded.

6.2 All component (pipe, fittings, vessel etc.) welds must be ground smooth. Sharp edges, fillets and similar abrupt contours shall be rounded by grinding or machining. No pin holes on the welds will be allowed.

6.3 Welds shall be profiled prior to abrasive cleaning and coating.

6.4 Before blast cleaning any surface imperfection remaining (after fabrication) such as sharp fins, weld spatter or furring & slag shall be removed from the surface.

6.5 Prior to abrasive cleaning, all oil, grease and other detritus materials shall be removed by solvent cleaning in accordance with SSPC-SP / Steel Structure Painting manual or any approved detergent washing or steam cleaning method. No residue that can affect adhesion shall be left on the surface.

6.6 Salt contamination shall be checked by the applicator using any NACE/SS PC approved method or SCM 400 salt contamination meter. Where values greater than 5 $\mu g/cm^2$ are detected the surface shall be cleaned by high pressure water jetting with fresh potable water. The surface shall be rechecked to ensure complete removal. Chloride can be removed by approved chemical method also.

6.7 The metal surface temperature shall be at least 3 ^oC above the dew point before abrasive blasting. If preheating is used, it shall be carried out in a uniform manner to avoid distortion of the weld joint etc.

6.8 The metal surface to be coated shall be grit blast cleaned to a SSPC-SP-5 / NACE-No-1 white metal blast cleaning.

6.9 Dust and blasting media shall be removed by brushing, vacuuming and dry compressed air jetting. A suitable procedure shall be produced by the applicator and approved by the Company for checking the integrity of the cleaned surface.

6.10 Blast surface finish shall be equal to grade SA 2.5 as described in Swedish Standard SIS-05-5900. Blast surface profile shall be a uniform sharp angular anchor profile with a height of 50 to 75 microns minimum 50 microns and shall be tested at various locations (i.e. approachable area) with Testex Press-04 and thickness gauges once per shift. The tapes shall be retained with the inspection records. However Comparator gauges to be used for checking blast surface finish for rest area.

6.11 The relative humidity reading shall be recorded every 2 hours during the blasting operation in the immediate vicinity of the operation. The relative humidity shall not exceed 85%.

6.12 The grit used for blasting shall be regularly checked for particle size and contamination to ensure that the required anchor pattern and contamination free surface is obtained.

6.13 Compressed air used for blast cleaning shall be clean, dry and free of moisture and oil. Moisture separators, oil separators, traps or other equipment may be necessary to achieve clean, dry air.

6.14 Blast cleaning operations shall be done in such a manner that no damage is done to partially or entirely completed portions of the work.

6.15 Dry blast cleaning shall not be conducted during times when the surface will become wet after blast cleaning or when ambient conditions are such that visible rusting occurs before coating. If any rust forms after blast cleaning, the surface shall be re-blasted before coating.

6.16 Where weld joints have been made proper care shall be exercised in the preparation of welds which before grit blasting shall be ground smooth and

have a minimum radius of 3 mm. Sharp edges, flux, weld spatter, pitting or holes will not allowed. All weld preparation shall be completed and inspected before blasting takes place. Welds shall be profiled prior to abrasive cleaning and lining. These requirements also apply to pipe seam welds.

6.17 When internal coating is required to maintain equipment alignment, all equipment flat face or rise face flanges shall be machined or ground to have a rebate 1.5 mm deep from the bore of the flange.. In case of internal coating of pipelines, 1.5 mm deep rebate/groove is not required on flat face or rise face pipe flanges. All flange corners/edges shall be ground smooth prior to grit blasting and should have a minimum 3mm radius.

6.18 **Defects**

6.18.1 When serious defects are found, such as scabs or metal silvers, gouges or laminations, following the Abrasive cleaning operation, the affected weld joint material or pipe spool shall be set aside for disposition by ENC.

6.18.2 If this anomaly affects enough of the weld joints or material to the extents the coating process is severely disrupted, the coating process shall be stopped and informed to Engineer-In-Charge. Applicator shall advise ENC of the remedial measures, if any, which shall be taken to achieve an acceptable coating surface.

6.18.3 Where the affected area can be reached the surface will be ground using materials and system which do not contaminate the metal surface. Any defect removed by grinding or filling shall be removed in such a manner that the wall thickness is not reduced below 95% of the nominal wall thickness.

6.19 The elapsed time between the start of blasting and coating shall not exceed the maximum as given in the following table

Relative Humidity	**Maximum Elapsed Time)**
Above 80%	2.0 hrs.
Upto 80%	3.0 hrs.
Upto 50%	4.0 hrs.

7 APPLICATION

7.1 The coating material shall be applied by applicators licensed by the material manufacturer as qualified to perform the work.

7.2 The coating material shall be applied in accordance with the manufacturer's recommendations. To this end the manufacturer shall state all relevant criteria for coating. This shall include but will not be limited to -

(a) Required surface temperature above the dew point of the surrounding air.

(b) Maximum permissible relative humidity.

(c) Limitations both upper and lower for substrate temperature under which coating may be applied.

(d) Licensed applicator shall take full cognizance of spool geometry.

All necessary safety precautions shall be undertaken prior to coating and as such a safety procedure shall be supplied by applicator for ENC approval prior to work commencement.

7.3 **Priming**

7.3.1 Priming shall not be done when ambient conditions are dusty or conducive to condensate formation on the steel substrate.

7.3.2 Before beginning priming and coating, measure the humidity using a sling psychrometer and calculate the dew point. The relative humidity must be lower than 85%. Temperature of steel surface must be at least 3 ^{o}C higher than the dew point. Under controlled conditions, it is possible to heat the steel surface to eliminate condensation problems.

7.3.3 The type of primer used shall be as described in the Material Specification Clause No. 3.2.

7.3.4 The blast cleaned steel shall be primed preferably within 2 hours of after blast cleaning but not more than 4 hours and under no circumstances the primer shall be applied to a surface where corrosion has occurred.

7.3.5 Primer shall be sprayed on to the cleaned surface in a fog coat as thinly as possible so as to tint but not mask the colour of the substrate. The primer on application shall be free from runs or drips or areas of excessive thickness.

7.3.6 The primed surface shall be protected so that it will not come into contact with rain, dust or other substances until completely hardened and coated with the Main Protective Coat.

7.4 The finished coating thickness and number of coats shall be as per clause-3.4.

7.5 Every effort shall be made to maintain an even film thickness at or around the preferred values. Any thickness values outside of the range given above will be cause for the application of a further coat or coats to attain the minimum film thickness or in the case of excessively over thick coating stripping and recoating.

7.6 Entire thickness shall be built up in single applications (with a number of passes). If the surface is large enough to require more than one day for the

coating, the edges of the coated areas shall be feathered and roughened prior to beginning of priming and coating on adjacent un coated area.

7.7 Coatings shall be applied in accordance with the manufacturers latest published instructions. In particular the manufacturer's recommended curing and drying times shall be allowed between coats, where multiple coats are applied.

7.8 All equipment's flange faces, Internal coating shall be terminated within groove so that alignment will not get disturbed Coating thickness shall be same as internal thickness and not to exceed 1.5 mm i.e. groove thickness. In case of pipe line flanges, Internal coating to be continued on flange face also. External coating shall be carried out at all metal surfaces including bolt holes excluding gasket area. Coating should never be terminated at edges/ corners; it should be terminated at flat area. When internal coating and external painting is specified, then flange face internal coating to be terminated at flange outer vertical face. When external coating is specified without internal coating then external coating should be terminated on flange gasket face.

7.9 When coatings are to be applied humidity and contamination is of major concern and therefore the coating shall not be applied if the following conditions prevail :

- When the temperature of the surface to be coated is less than 3 ^{o}C above the dew point of the surrounding air and / or the relative humidity is higher than 85%.
- When the base metal temperature is greater than that recommended in writing by the coating manufacturer as suitable for application of the product.
- When the temperature is below 4 ^{o}C.
- When there is likelihood of an un-favorable change in the weather conditions within 2 hours after application of the coating.
- Wind blown Abrasive or dust which may contaminate either the blast surface or become included in the wet paint film.
- When there is deposition of moisture in the form of rain or condensation.

7.10 Before application on the substrate apply a test patch for runs or drips and gel time as well as tack free time. Test for adhesion if in doubt.

7.11 At the ends of pipe joints where welding is to take place a cut back (160 mm) may be allowed in the coating depending on the field joint coating method selected. The actual distance if any, shall be agreed

prior to application. This shall be achieved by masking off circumferentially the required area including Bevel End to prevent coating deposition.

7.12 The cured lining shall be of uniform colour and gloss and shall be free of blisters, fish eyes, sags or runs and any other irregularities.

7.13 Areas not to be coated shall be masked with disposable plastic sheets, tapes, cardboard etc.

7.14 Equipment for the spray application shall be Airless Spray equipment with system specification meeting minimum specified by the coating manufacturer. Equipment shall consist of Material Feed Pumps, Purge Pump, Proportioning Pump, Mix Manifold, Static Mixer, Interconnecting Hoses etc. System shall normally be capable of 1500-3000 Psi fluid pressure (at tip) and a material supply rate of 4 – 10 litres / minute.

7.15 The proportioning pump shall be fitted with a numeric counter to keep track of the volume (the proportioning pump delivers a precise volume of materials per stroke) of materials being used while spraying. The applicator shall calculate the steel unit area, material volume and counter numbers required, approximate speed (litres / minutes) based on spray tip size as well as number of passes and spray coating materials according to these criteria. The equipment used shall result in a smooth film being laid down over the prepared substrate.

7.16 Coatings, catalysts and thinners shall be stored in well ventilated buildings free from excessive heat, sparks, flames and direct sunlight. Coatings stored for short periods on the job site shall be protected from direct sunlight during summer months. Partially used and unused material drums must be tightly sealed and contained with a blanket of nitrogen to prevent moisture contamination when not in use. Containers shall not be opened prior to use except for spot inspection. They shall be tightly resealed after inspection.

7.17 The field weld joint coating and a repair procedure for review and approval by the Engineer-in-charge. The repair procedure shall be for coating holidays and defects up to 50 mm in diameter only. All detects or areas requiring recoating which are above the 50 mm criteria shall be cause for complete stripping and recoating of the entire field joint and weld joint and repair coating qualification, inspection and testing shall comply with Section.

7.18 During coating application, at least once per shift the applicator shall blast clean and coat one test plate to the same standard as the base material being coated. Test plates shall be marked with a sequential alpha numeric system so that they may be traceable back to the related shift and component coated during the shift. The test plates shall be

allowed to cure and shall be subjected to the relevant tests applicable for coating e.g. pull off test.

8 INSPECTION AND TESTING

8.1 Quality Requirements

The applicator quality assurance procedure shall include as a minimum the following

(a) Checking cleanliness of all components immediately prior to blasting.

(b) Monitoring of size, shape, dryness and cleanliness of the blasting material and process.

(c) Checking visually in good light, the surface of the weld joints/spool piece for metal defects, dust and surface debris.

(d) Checking weld joint/spool piece surface blast profile.

(e) Checking thickness of cured coating.

(f) Holiday detection of 100 per cent of the surface area of all coated components.

(g) Supervision of adequate and prior repair of all defects.

(h) Checking of coating colour, appearances and uniformity.

8.2 Responsibility for Inspection

8.2.1 The applicators qualified inspector shall be approved by the ENC

Applicator shall be responsible for all quality control checking including visual inspection, thickness measurements, holiday testing and shall keep records of the results of all such inspections in forms. Sample forms of records to be maintained are enclosed as Appendix-A to E with this specification. These approved forms to be used for recording inspection.

8.3 Visual Inspection

8.3.1 The internal surface of the coated material at each stage of operation shall be inspected visually using suitable illumination and inspection tests with sufficient frequency to assure full compliance with the requirements.

8.3.2 Blast surface profile using Kean Tapor Comparator or equivalent surface profile gauge. The average of reading from five randomly selected areas shall constitute the average surface profile. Test area to be flat (without curvature).

8.4 **Thickness Tests**

8.4.1 The pipe shall be checked using non-destructive type of thickness gauge.
All results shall be as specified in clause 3.4 of this specification and shall be recorded.

8.4.2 The dry film thickness shall be checked with a thickness Gauge. The average of readings from five randomly selected areas shall constitute the film thickness. Individual readings shall not vary by more than 25% from the mean.

8.5 **Holiday Detection**

Following application of coatings and after curing the coating shall be 100% holiday tested using a high voltage d.c. detector.

8.5.1 100% of the internally / externally coated surface area of the material shall be holiday detected employing an audible signaling device. The electrode used for locating holidays shall be designed to ensure direct contact with the coating and provide complete coverage of the whole coated surface.

8.5.2 The detector shall be subject to approval by the ENC and of a type which maintains intimate contact with the coating. It can be of either the constant of pulsed type, but if the former is used it shall be used on dry coating under dry conditions. The operating voltage between the electrode and metal shall be checked at least twice per working shift.

8.5.3 Holiday testing using high voltage holiday detector (Tinker Rasor or equivalent) as per NACE International RP 0168-90 “Holiday Testing”. Coating to have cured atleast 24 hours prior to holiday test. Due care should be taken not to use voltage exceeding the dielectric strength of the coating. Voltage recommended by manufacturer to be followed. The location of the holidays shall be noted on the coated surface for repair.

8.5.4 The detector shall be set such that the voltage is suitable for use on a thin film coating and does not create holidays by burn through.

8.5.5 The travel rate of the detector electrode shall not exceed 30 cm/s (1 ft/s) and shall not be allowed to remain stationary while the power is on.

8.5.6 Holiday detection will be conducted at 100 to 125 volts DC per 25 micron of coating.

8.5.7 The detector shall be calibrated at least twice per shift.

8.5.8 No holidays are acceptable and all holidays shall be repaired. The average and maximum repair rates allowable for holidays shall be :

Average 4 per day.

Maximum 10 in any one days production.

If the maximum number is exceeded, or the daily average if exceed for any 5 consecutive days production, then application shall cease and the cause shall be investigated and resolved.

8.6 **Calibration of Inspection Equipment**

8.6.1 The coating thickness gauge (See Para 8.3) shall be calibrated at the start of production and every 3 hours during production, against a certified or known standard.

8.6.2 The holiday detector shall be calibrated at least twice per 8 hour shift against a suitably calibrated voltmeter and adjusted to ensure that voltage is sufficiently high to detect an intentional pinhole holiday through the coating on the material like pipe and vessel or equipment.

8.7 **Production Testing**

8.7.1 During coating application and at least once per shift it shall be blast cleaned and coated two test plates to the same standard as the coated metal surface. They shall be marked with a sequential alpha numeric system, so that they may be traceable back to the related shift and weld joints or sections coated during that shift the test plates shall be allowed to cure and shall be subjected to the following tests –

- Adhesion testing by pull off test method.
- Holiday test, 100% area of test panel, no holidays are acceptable.
- Dry film thickness.

Failure to meet the requirements of the above will result in further testing on the related production coating at a frequency dictated by the ENC to establish the extent of the potential problem.

8.8.1 Defective work shall be corrected.

9.0 COATING PROCEDURE QUALIFICATION TESTING

9.1 Prior to production coating, two or four string lengths of pipes or sample pieces shall be prepared and coated to establish that the coating operation and coating material meets the requirements of this specification.

9.2 Quality control tests shall be performed on the pre-production coated pipe strings or sample pieces as follows –

- Blast cleanliness standard and profile inspection, profile shall be confirmed with a suitable comparator or film tap.
- Evacuation of all blast Abrasive from the pipe.
- Chloride testing inspection.
- Visual inspection of coating, two panels 150 mm x 150 mm shall be cut from each joint of the string at the spiral weld or seam weld. This shall be examined for coating thickness at the weld edges and crown.
- Thickness testing.
- Holiday inspection.
- Repair procedure

No production shall commence until all of the above tests are done to the complete satisfaction of the ENC

10.0 FIELD JOINT AND REPAIR OF COATING

Where pre-coated pipe joints are used or where tie-in or closing welds are made the following section shall apply –

10.1 The field joint coating system to be used on field (closing weld) joints and repair areas shall be based on the base coating system.

10.2 All proposals to use alternative or equivalent material shall be forwarded to ENC for approval.

10.3 The field joint and repair coating shall be applied to the coating thickness as specified in para 3.4.of this Section.

10.4 It is requirement that the procedures shall be pre-qualified for the application of all field joint and repair materials, and shall satisfy the ENC that he has the knowledge and expertise to apply the specified system.

10.5 **Field Joint and Repair Coating Procedure Qualification Testing**

10.5.1 The field joint area shall be grit blasted in accordance with the requirements of para 6.0 of this Section..

10.5.2 All field joints shall be suitably feathered at the edges, such that there is a smooth transition from the edge of the existing coating to the newly applied field joint coating.

10.5.3 Application of all field joint coating and repair coating materials shall be strictly in accordance with the manufacturer's data sheets / instructions.

10.5.4 A pre-qualification test shall be carried out on a field joint and a simulated repair to the pipeline coating prior to production and shall cover as a minimum all items as specified in para 9.0 of this Section.

10.6 **Production Testing of Field Joints**

10.6.1 During field joint application and at least one per 50 field joints shall be tested and shall be subject to all the testing and requirements as specified in para 8.0 of this Section.

10.7 **Production Testing of Repair Areas**

10.7.1 As it is anticipated that there will be a limited number of repairs to coated pipes, therefore the repaired area of pipe shall undergo the following tests only :

- Holiday tested.
- Dry film thickness check.
- Visual (there shall be smooth transition from the base coating to the repaired area).

11.0 STORAGE, HANDLING, TRANSPORTATION & INSTALLATION

11.1 Lined equipment / piping spools shall be stored under cover or in a protected compound. When necessary, linings shall be shielded from direct sunlight.

11.2 All branches, manholes and other openings shall be protected from mechanical damage by using wooden blanks or other suitable material.

11.3 Lifting shall be arranged such that chains and other lifting aids do not come into contact with lined surfaces.

12.0 DOCUMENTATION

12.1 Ten copies of following approved documents shall be submitted.

(a) Coating Manual.

(b) History Docket.

12.2 After execution of the job Coating Manual should be revised covering coating procedures, coating material specifications, coating equipment used, test procedures, test report forms and repair procedure actually used during execution of the job.

12.3 History Docket of approved QAP, Inspection and Test result reports on coating material, metal surface condition, coating thickness and various test results conducted during coating and after coating at field and at lab.

ANNEXURE-1

MINIMUM REQUIREMENT FOR COATING

Sl. No.	Parameters	Test Code	Specification / Requirement / Value
1.0	**Coating Details**		
1.1	Type		Two component, solvent free, high build Polyurethane Coating
1.2	Resin		Tar free Polyurethane
1.3	Filling Ingredient		Nil
1.4	Volume of Solids	ASTM – D-2697	Above 99%
1.5	Solvent		Nil
1.6	Curing		Ambient cured.
1.7	VOC		Nil
2.0	**Physical Properties**		
2.1	Tensile Strength at yield	ASTM D 638	$\geq$ 15 N/ mm^2
2.2	Shear Strength at yield	ASTM D 638	$\geq$ 15 N/ mm^2
2.3	Impact Resistance	ASTM G-14/ D 2794	$\geq$ 23 N/ mm^2
2.4	Hardness Shore D	ASTM D 2240	> 60
2.5	Flexural Property	ASTM D-522	Pass 180 Deg bend over ½ inch mandrill with 650 micron coating
2.6	Recoverable Elongation	ASTM D412 / D638	$\geq$ 50%
2.7	Color		Grass Green
3.0	**Service Properties**		
3.1	Adhesion to Carbon	ASTM D-4541	$\geq$ 10 N/ mm^2
3.2	Temperature Resistance	-	Dry $\leq$ 80 ^{0}C ; Wet $\leq$ 50 ^{0} C
3.3	Abrasion Resistance [Material Loss for 1000 cycle at 1 kg load with CS17 wheel]	ASTM - D – 4060	$\leq$ 50 mg
3.4	Cathodic dis-bonding in 30 days	ASTM G 8 / G 95	Dislocation < 5 mm
3.5	Water vapour permeability/ Transmission rate in 24 hrs.	ASTM D 1653 / ASTM F 1249	$\leq$ 0.3 GM / M^2
3.6	Accelerated weathering (2000 hrs)	ASTM G-154	Colour change, cracking and blistering, loss of gloss, chalking etc not allowed.
4.0	Chemical resistance immersion of 30 days in sea water -		
	% wt change	Respective Test Code	< 1.0%
	% hardness change		< 5%
	% tensile strength change		< 5%
	% bond strength change		< 5%

ANNEXURE-2

Sheet 1 of 2

DATA TO BE FURNISHED BY THE COATING CONTRACTOR

Sl. No.	Parameters	Test Code	Value / Details
1.0	**Coating Details**		
1.1	Type		
1.2	Resin		
1.3	Filling Ingredient		
1.4	Volume of Solids	ASTM – D - 2697	
1.5	Total coating thickness to be achieved as per Tender.		
1.6	No. of main coats considered for achieving required thickness		
1.7	Each coat thickness		
1.8	Surface preparation method		
1.9	Surface profile required		
1.10	Primer required (Type)		
1.11	Primer coat thickness		
1.12	Blasting material to be used – ``for carbon steel surface		
	``for stainless steel surface".		
2.0	**Main Coat Physical Properties**		
2.1	Tensile Strength at yield	ASTM D 638	
2.2	Shear Strength at yield	ASTM D 638	
2.3	Impact Resistance Forward/Reverse	ASTM G-14 / D 2794	
2.4	Compressive Strength	ASTM D 695	
2.5	Hardness	ASTM D 2240	
2.6	Flexural Property	ASTM D-522	
2.7	Recoverable Elongation	ASTM D-412 / D 638	
2.8	Color		
3.0	**Service Properties**		
3.1	Adhesion to Carbon / Stainless Steel	ASTM D-4541	
3.2	Temperature Resistance	-	
3.3	Abrasion Resistance [Material Loss for 1000 cycle at 1 kg load with CS17 wheel]	ASTM - D – 4060	
3.4	Cathodic disbonding in 30 days	ASTM G 8/ G 95	
3.5	Water vapor permeability/ Transmission rate	ASTM D 1653 / F 1249	

Sl. No.	Parameters	Test Code	Value / Details
3.6	Accelerated weathering (2000 hrs)	ASTM G-154	
3.7	Chemical resistance immersion of 30 days in sea water -		
	% wt change	Respective Test Code	
	% hardness change		
	% tensile strength change		
	% bond strength change		
3.8	Thermal Coefficient of Linear Expansion		
3.9	Dielectric Strength		
4.0	**Application Properties**		
4.1	Flash point		
4.2	Catalyst type		
4.3	Mixing ratio		
4.4	Practical spreading rate		
4.5	Curing time		
	- for next coat		
	- for full cure		
	- for continuous service		
4.6	Pot life at 30 ^{o}C		
4.7	Thinner if any		
4.8	Storage life / Shelf life		
4.9	Cleaning fluid		

APPENDIX–A

COATING SCHEDULE

Project Name :
Client :
W.O. No. :

Inspection Agency :
Site :
Others :

SURFACE DESCRIPTION (STEEL, SURFACE A,B (ECT)	APPROX. SURFACE AREA SQUARE METER	SURFACE PREPARATION TYPE	PROFILE RANGE	FIRST COAT			SECOND COAT			THIRD COAT		
				TYPE	WFT / DFT	COLOUR	TYPE	WFT / DFT	COLOUR	TYPE	WFT / DFT	COLOUR

APPENDIX-B
SHEET: 1 OF 3

COATING SYSTEM DAILY INSPECTION REPORT

DATE	REPORT NO.	PROJECT REF. NO.	PAGE OF
PROJECT DESCRIPTION	LOCATION	CONTRACTOR	
INSPECTION ORGANISATION	INSPECTOR	APPLICABLE SPECIFICATION NO.	

I. **DESCRIPTION OF ITEMS AND / OR AREAS**

II. **DESCRIPTION OF WORK PERFORMED / REMARKS**

III. **PRE-WORK SURFACE CONDITION**

- SUBSTRATE _____
- GENERAL DESCRIPTION _____ _____
- PRIMED FOR SUBSEQUENT COATS.
- REFERENCE REPORT DATED ----------
- PREVIOUSLY PAINTED – DEGREE OF CORROSION ----------
- NEW METAL – DEGREE OF CORROSION ----------

OBSERVED DEFECTS

OIL & GREASE □ □

SHARP EDGES □ □

WELD SPATTER □ □

MOISTURE □ □

LAMINATIONS □ □

SOLUBLE SALTS □ □

---------- □ □

---------- □ □

IV. **ENVIRONMENTAL CONDITIONS**

TIME ----------

AIR TEM/^{O}C ----------

WET BULB TEMP ^{O}C ---------

RELATIVE HUMIDITY ^{O}C ----------

DEW POINT ^{O}C ----------

SURFACE TEMP MIN / MAX. ^{O}C ----------

REMARKS :

APPENDIX-B

SHEET 2 OF 3

COATING SYSTEM DAILY INSPECTION REPORT

V. **SURFACE PREPARATION** □ ABRASIVE BLAST

O SOLVENT CLEAN ---------- ABRASIVE TYPE ----------
O HAND TOOL ---------- BLAST NOZZLE PRESSURE --
O POWER TOOL ---------- SURFACE PROFILE (AVG) ---
O HP WATER WASH ---------- DEGREE OF SURFACE CLEANLINES
O ---------- COMPRESSED AIR CLEANLINESS

START TIME ---- STOP TIME ----
APPROXIMATE SQ. MT PREPARED -------
REMARKS ----------

VI. **PRODUCT / MIXING**

COATING PRODUCT TYPE CATALOGUE NO. / NAME COLOUR

--- --- ---

TIME MIXED -------
KIT SIZE ----------

COATING BATCH NUMBER

A. ---------- □ FIRST COAT

B. ---------- □ SECOND COAT

C. ---------- □ THIRD COAT

LTR MIXED ----------

CONTAINER CONDITION ----------

PROPERLY STORED ? ----------

MIXING INSTRUMENT ----------

MATERIAL TEMP. ºC ----------

REMARKS ----------

VII. **COATING APPLICATION**

METHOD OF APPLICATION ----------

EQUIPMENT DESCRIPTION ----------

AIR CLEANLINESS ----------

BRUSHED STRIPE COAT APPLIED TO HARD TO COAT AREAS? ----------
---

START TIME --- STOP TIME ----

APPROXIMATE SQ. MT COATED --------

LTR. COATING APPLIED -------

REMARKS ----------
----------WET FILM THICKNESS (AVG) ---------- MILS

VIII. **POST CURE INSPECTION**

□ DFT GUAGE ACTUAL DATE WORKSHEET READING ATTACHED

SURFACE EFFECT ON GAUGE----------

TOTAL DFT FROM PREVIOUS COATS (AVG) ----------

DFT THIS COAT----------

GENERAL APPEARANCE / REMARKS

IV. NON CONFORMANCE ITEMS

DESCRIPTION OF DEFECTS	DEFECTIVE ITEMS/AREA	SPECIFICATION PEF. SECTION	N.C.R. NO.	DATE CORRECTED
---	---	---	---	---
---	---	---	---	---
---	---	---	---	---

INSPECTOR'S SIGNATURE

DATE

APPENDIX-B

SHEET 3 OF 3

COATING SYSTEM DAILY INSPECTION REPORT

Date :

Project Ref. No. :

Report No. :

Page No. :

TIME	REMARKS

INSPECTOR'S SIGNATURE

DATE

APPENDIX-C

DRY FILM THICKNESS MEASUREMENT WORKSHEET

DATE	REPORT NO.	PROJECT REF. NO.	APPLICABLE SPECIFICATION	PAGE OF

ITEM / AREA DESCRIPTION	SPOT	SPOT READINGS (MICRON)			TOTAL	AVERAGE	% MIN	REMARKS
		1	2	3				
	A							
	B							
	C							
APPROX. SQ. MTR	D							
	E							

TOTAL
AVG

SPECIFICED DFT---------- MICRON
RANGE ACHIEVED ---------- MICRON

REFERENCE REPORT DATED ---------- FOR APPLICATION RECORD

REMARKS

INSPECTOR'S SIGNATURE DATE

APPENDIX–D

FIELD JOINT COATING INSPECTION REPORT

ITEM SIZE **DATE**

ITEM SERVICE SHEET

OF

NAME OF CONTRACTOR

SR. NO.	JOINT NO.	SURFACE PREPARATION					Coating Thickness DFT	No. of Holidays	Repair Status	Final Status	Initials
		Temperature	RH	Dew Point Temperature	Profile	Deg. Of care (Sa 2 ½)					
1.											
2.											
3.											
4.											
5.											

APPENDIX-E

HOLIDAY DETECTION WORKSHEET

DATE	REPORT NO.	PROJECT REF. NO.	APPLICABLE SPECIFICATION	PAGE OF
ITEM / AREA DESCRIPTION SPOT	NO. OF DEFECTS FOUND		APPROX. AREA IN SQ. MTS	AVERAGE DFT

REMARKS

INSPECTOR'S SIGNATURE DATE

The list of sub-vendors acceptable to the PURCHASER for major equipment / services is enclosed in this section. **Although number of sub-vendors has been listed, CONTRACTOR shall themselves ascertain the present technical and financial capability of the suppliers for the supply of items prior to placement of PO to sub-vendors.** In case of any difficulty, the CONTRACTOR can also propose alternate sub-vendors with documentary evidence and proper justification for review and approval by PURCHASER. In such cases, the CONTRACTOR shall evaluate these vendors with respect to their technical and financial capabilities, order booking position, adhering to delivery schedule etc. and submit the report to PURCHASER for review and approval. It shall be CONTRACTOR'S responsibility to **ascertain the present technical and financial capability of the sub vendors listed in this section for the supply of items prior to placement of PO to sub-vendors.** It shall be CONTRACTOR'S responsibility to ensure that the vendor selected implements the quality assurance programme in line with PURCHASER's quality assurance programme and meeting the requirements of tender specification. CONTRACTOR shall note that there shall not be any price implication in the event of PURCHASER not approving the alternate sub-vendors suggested by them and the contractor having to restrict his choices within PURCHASER provided sub-vendor list given in this section.

LIST OF SUGGESTED SUB-VENDORS FOR TURBINE ISLAND PACKAGE

Sr. No.	Item /Equipment / Package Detail	Supplier / Contractor name (Indian Vendor)	Supplier / Contractor address	Supplier / Contractor name (Foreign Vendor)	Supplier / Contractor address
A	**MECHANICAL ITEMS**				
1	HP TURBINE CASING CASTINGS	1. M/S. STAR WIRE INDIA LTD	BALLABHGARH	1. M/S. CHINA NATIONAL ERZHONG GROUP CO.	CHINA
				2. M/S. DALIAN HEAVY INDUSTRIES STEEL CASTING CO. LTD.	CHINA
				3. M/S. DOOSAN HEAVY INDUSTRIES	SOUTH KOREA
				4. M/S. JAPAN CASTING AND FORGING CORPORATION (JCFC)	JAPAN

				5. M/S. VOEST ALPINE LINZ	AUSTRIA
2	HP/LP ROTOR SHAFT FORGINGS			1. M/S. A. FINKL & SONS	USA
				2. M/S. BUDERUS EDELSTAHLWERKE GMBH	GERMANY
				3. M/S. CHINA FIRST HEAVY INDUSTRY	CHINA
				4. M/S. DOOSAN IMGB	ROMANIA
				5. M/S. DOOSAN HEAVY INDUSTRIES	SOUTH KOREA
				6. M/S. ENERGOMASHSPETSSTAL	UKRAINE
				7. M/S. FOMAS S.P.A.	ITALY
				8. M/S. FORGE MONCHIERI	ITALY
				9. M/S. JAPAN CASTING AND FORGING CORPORATION (JCFC)	JAPAN
				10.M/S. JAPAN STEEL WORKS (JSW)	JAPAN
				11.M/S. SAARSCHMIEDE GMBH	GERMANY
				12.M/S. SCHMIEDEWERKE GRODITZ GMBH	GERMANY
				13.M/S. SHEFFIELD FOREGEMASTERS ENGINNERING (SFEL)	UNITED KINGDOM
				14. M/S. SOCIETA DELLE FUNCINE	ITALY
3	GENERATOR ROTOR SHAFT FORGING			1. M/S. CHINA FIRST HEAVY INDUSTRIES	CHINA
				2. M/S. SAARSCHMIEDE	GERMANY
				3. M/S. JAPAN CASTING & FORGING CORPORATION	JAPAN
				4. M/S. BUDERUS EDELSTHAL	GERMANY
				5. M/S. SOCIETA DELLE FUNCINE	ITALY
				6. M/S. SUMITOMO CORPORATION	JAPAN
4	GENERATOR RETAINING RING FORGING			1. M/S. SAARSCHMIEDE, GMBH	GERMANY
				2. M/S. ENERGIETECHNIK	GERMANY
				3. M/S. SUMITOMO CORPORATION	JAPAN
				4. M/S. AUBERT & DUVAL	FRANCE

5	LUBE OIL PURIFICATIO N UNIT	1. M/S. VATS FILTERATION TECHNOLOGIES, PUNE	PUNE	1. M/S PALL FILTERATION	USA
		2. M/S. ALFA LAVAL	PUNE	2. M/S. FACET	SPAIN
6	CLADDED PLATES OF MSR & CONDENSER	1. IDL EXPLOSIVES LTD	HYDERABAD	1. M/S. METAL ONE CORPORATION	JAPAN
				2. M/S. VOESTALPINE	AUSTRIA
				3. M/S. HANWHA CORPN.	KOREA
				4. M/S. KOBE STEEL LTD.	JAPAN
				5. M/S. MARUBENI ITOCHO STEEL INC.	JAPAN
				6. M/S. ASAHI-KASEI	JAPAN
				7. M/S. JAPAN STEEL WORKS (JSW)	JAPAN
	-				
7	HP-MSR- LP (CRH, HRH PIPES.)	1. M/S. BEND JOINT PVT. LTD.	BHOPAL		
		2. M/S. GUJRAT INFRA PIPES	VADODARA		
		3. M/S. UNITECH MACHINES LTD	SAHARANPUR		
		4. M/S. DEE DEVELOPMENT (INDIA)	PALWAL		
		5. M/S. STEWARTS AND LLOYD OF INDIA LTD	KOLKATA		
8	CONDENSER VACUUM PUMPS			1. M/S. GARDNER DENVER NASH MACHINERY	CHINA
				2. EDWARD	UK
9	LUBE OIL PUMPS (AUXILIARY OIL PUMPS AND EMERGENCY OIL PUMPS)	1. M/S. MATHER AND PLATT PUMPS LTD.	PUNE	1. M/S. COLFAX-ALLWEILER	GERMANY
		2. M/S. KIRLOSKAR BORTHERS LTD.	PUNE	2. M/S. RUTCHI	FRANCE
10	SEAL OIL PUMP	1. M/S. TUSHACO PUMPS	DAMAN	1. M/S. ALLWEILER	GERMANY
		2. M/S. UT PUMPS & SYSTEMS	FARIDABAD		
11	PRIMARY WATER PUMP	1. M/S. KSB PUMPS	PUNE		

		2. M/S. SULZER PUMPS	INDIA		
12	JACKING OIL PUMP			1. M/S. HYDAC FILTERCHNIK, GMBH	GERMANY
				2. M/S. BOSCH REXROTH	GERMANY
13	LUBE OIL PURIFICATIO N UNIT	1. M/S. VATS FILTERATION TECHNOLOGIES, PUNE	PUNE	1. M/S PALL FILTERATION	USA
		2. M/S. ALFA LAVAL	PUNE	2. M/S. FACET, SPAIN	SPAIN
				3. M/S. KAYDON	USA
14	MAIN OIL TANK AND TURBINE OIL STORAGE TANK	1. M/S. GLOBAL HEAVY ENGINEERING, BHOPAL	BHOPAL		
		2. M/S. PAL ENGG., CORPORATION, YAMUNAGAR	YAMUNAGAR		
		3. M/S. SHREE KUSHAL FABRICATORS, BHOPAL	BHOPAL		
		4. M/S. STEEL CRAFT, YAMUNAGAR	YAMUNAGAR		
		5. M/S. STEEL INNOVATIONS PVT., LTD., BHOPAL	BHOPAL		
		6. M/S. DENSER INDUSTRIES, NAGPUR	NAGPUR		
15	ENGINEERIN G CONSULTAN TS	1. M/S. DCPL	KOLKATA		
		2. M/S. TCE	MUMBAI		
16	CIVIL CONSTRUCTI ON AGENCIES	1. M/S. LARSEN & TOUBRO	MUMBAI		
		2. M/S. HINDUSTAN CONSTRUCTION CO.	MUMBAI		
		3. M/S. GAMMON INDIA LTD.	MUMBAI		
		4. M/S. SIMPLEX INFRASTRUCTURES LTD.			
		5. M/S. AFCONS INFRASTRUCTURES			

		LTD.			
		6. M/S SHAPOORJI PALLONJI	MUMBAI		
		7. M/S BRIDGE & ROOF	KOLKATA		
		8. M/S GANNON DUNKERLEY & CO.	KOLKATA		
		9. M/S INDU PROJECTS LTD.	HYDERABAD		
		10. M/S PETRON CIVIL ENGG. PVT. LTD.	MUMBAI		
-	-				
17	SEAMLESS PIPES (CS, AS AND SS)	1. M/S. MSL, RAIGAD	RAIGAD	1. M/S S.C. PETROTUB	ROMANIA
		2. M/S. ISMT, PUNE	PUNE	2. M/S DALMINE	ITALY
		3. M/S REMI METALS GUJARAT LTD., MUMBAI	MUMBAI	3. M/S VALLOUREC AND M/S MANNESMANN THYSSENKRUPP	GERMANY
		4. M/S. JINDAL STEEL TUBES	KOLKATA	4. M/S PRODUCTOS TUBULARES	SPAIN
		5. M/S. ZENITH STEEL TUBES	MUMBAI	5. M/S WYMMAN GORDON	USA
		6. M/S. RATNAMANI METALS AND TUBES LTD	AHMEDABAD	6. M/S SUMITOMO CORP.	JAPAN
		7. M/S. NFC	HYDERABAD	7. M/S TUBOS REUMIDIS	SPAIN
		8. M/S. SURAJ LIMITED.	AHMEDABAD	8. M/S COMMERCIALE TUBI ACCIAIO SPA.	ITALY
				9. M/S. AB SANDVIK	SWEDEN
				10. M/S. SALZGITTER MANNESMANN	FRANCE
				11. M/S. SCHOELLER BLACKMANN	AUSTRIA
				12. M/S. YANGZHOU CHENGDE STEEL PIPES CO., LTD.	CHINA
				13. M/S KASCO	SOUTH KOREA
18	WELDED PIPES (CS, AS)	1. M/S. MANN INDUS.	INDORE		
		2. M/S. DECCAN METAL INDUSTRIES, RAJPURA	PUNJAB		

		3. M/S. LALIT PIPES & PIPES LIMITED	KASARA		
		4. M/S. MSL	RAIGAD		
		5. M/S. RATNAMANI	AHMEDABAD		
19	SS TUBES	1. M/S. RATNAMANI	AHMEDABAD	1. M/S. FINE TUBES	UK
		2. M/S. NFC	HYDERABAD	2. M/S. VALLOUREC & MANNESMAN	GERMANY
		3. M/S. CST VALINOX	HYDERABAD		
		4. M/S REMI METALS GUJARAT LTD.	MUMBAI		
20	FORGED AND WELDED FITTINGS	1. M/S. DEE DEVELOPMENT	FARIDABAD	1. M/S. SUNGKWANG BEND CO.	SOUTH KOREA
		2. M/S. ARVIND METAL PIPES & FITTINGS	VADODARA	2. M/S. TECHTUBE	ITALY
		3. M/S. STEEL SAMRAT	TARAPUR	3. M/S. UNION PIPING	ITALY
		4. M/S. GUJARAT INFRA PIPES	VADODARA	4. M/S. ERNE	AUSTRIA
		5. M/S. MS FITTINGS	KOLKATA	5. M/S. PETROL RACCORDI	ITALY
		6. M/S. ECHAY INDUSTRIES, MUMBAI(FLANGES)	MUMBAI	6. M/S. M. E. G. A, SPA	ITALY
		7. M/S. PARAMOUNT FORGE, PANVEL, MAHARASHTRA (ONLY FOR FLANGES)	PANVEL, MAHARASHTRA	7. M/S BASSI LUIGI	ITALY
		8. M/S. HILTON METAL FORGINGS LTD	MUMBAI	8. M/S SCHULTZ	GERMANY
		9. M/S. STEWARDS & LLOYDS	CALCUTTA	9. M/S B.K.L. FITTINGS LTD	UK
		10. M/S. SWASTIK LLOYDS ENGINEERING PVT LTD	MUMBAI	10. M/S RACCORDI FORGEATI	ITALY
		11. M/S. TEEKAY TUBES	MUMBAI	11. M/S MYONG KWANG METAL CO.	SOUTH KOREA
		12. M/S. TRUE FAB PVT LTD.	FARIDABAD	12. M/S TEE KWANG	SOUTH KOREA

		13. M/S. S&G ENGINEERS PVT. LTD.	FARIDABAD	13. M/S FINO	GERMANY
		14. M/S. CHW FORGE PRIVATE LIMITED	HARYANA	14. M/S. JIANYIN LONGSHAN PIPE SOLUTION CO. LTD.	CHINA
		15. M/S. TECHNO PRODUCTS INDUSTRIES	GUJARAT		
21	PIPING FABRICATOR	1. M/S. GUJRAT INFRA PIPES	VADODARA	1. M/S. BASSI LUIGI, (SIMAS)	ITALY
		2. M/S. UNITECH MACHINES LTD	GURGAON		
		3. M/S. DEE DEVELOPMENT	FARIDABAD		
		4. M/S. BEND JOINTS	BHOPAL		
		5. M/S. PAL ENGG., CORPORATION	YAMUNAGAR		
		6. M/S. BHEL, TRICHY	TRICHY		
22	FILTER AND STRAINER	1. M/S. DRAYTON GREAVES	MUMBAI		
		2. M/S. JAYASHREE INDUSTRIES	HYDERABAD		
		3. M/S. MULTITEX	DELHI		
		4. M/S. PROCEDYNE ENGINEERS	CHENNAI		
		5. M/S. FILTERATION ENGINEERS	NAVI MUMBAI		
		6. M/S. GUJARAT OTOFILT	AHMEDABAD		
		7. M/S. FLASH POINT EQPMT. PVT. LTD.	PUNE		
		8. M/S. JAGTAP	VADODARA		
		9. M/S. SUPERFLOW	MUMBAI		
		10. M/S. HAWA VALVES	AHMEDABAD		
		11. M/S. KIRLOSKAR MAHALE FILTERS	PUNE		
		12. M/S. PAL ASSOCIATES	AHMEDABAD		
		13. M/S. PURELATOR	DELHI		

23	METALLIC EXPANSION BELLOWS	1. M/S. METALLIC BELLOWS	CHENNAI		
		2. M/S. FLEXICON BELLOWS	VADODARA		
		3. M/S. SUR INDUSTRIES	KOLKATA		
		4. M/S. FLEXTHERM EXPANSION BELLOW(P) LTD	VADODARA		
		5. M/S. LONESTAR	CHENNAI		
		6. M/S. PRECISION BELLOWS	AHMADABAD		
		7. M/S. FLUIDYNE ENGINEERS	CHENNAI		
24	HANGERS, SUPPORTS	1. M/S. BHEL	TRICHY		
		2. M/S. PIPE HANGERS AND SUPPORTS PVT., LTD.	CHENNAI		
		3. M/S. SARATHI ENGINEERING LTD	HYDERABAD		
		4. M/S. PIPING AND ENERGY PRODUCTS	DELHI		
		5. M/S. SPRING SUPPORTS MANUFACTURING CO.	KOLKATA		
25	FASTENERS	1. M/S. ALCO	HUBLI		
		2. M/S. BOLTMASTER	VASAI		
		3. M/S. GKW	MUMBAI		
		4. M/S. INDUSTRIAL FASTENERS	MUMBAI		
		5. M/S. MEGA ENGINEERING PVT. LTD			
		6. M/S. LAXMI PRECISION	MUMBAI		
		7. M/S. PRECISION ENGINEERING INDUSTRIES	VADODARA		
		8. M/S. PRECISION FASTENERS	MUMBAI		
		9. M/S. TVS SUNDARAM FASTENERS	CHENNAI		
		10. M/S. TCS	CHENNAI		

		11. M/S. UNBRAKO	MUMBAI		
		12. M/S. PRESIDENT ENGG. WORKS	MUMBAI		
		13. M/S. PIONEER NUTS AND BOLTS PVT. LTD.	LUDHIANA		
		14. M/S. INDUSTRIAL ENGG. CORPORATION	VASAI		
		15. M/S. INDCON	DELHI		
		16. M/S. SUMMITS HYGRONIC	COIMBATORE		
		17. M/S. MULTIFASTENERS	VADODARA		
26	GASKET	1. M.S. STARFLEX	GOA	1. M/S.FLEXITALLIC	UK
		2. M/S. IGP	CHENNAI		
		3. M/S. SG GASKET AND COOLING TOWER CO.	MUMBAI		
27	PLATES AND STRUCTURAL STEEL (CS & SS)	1. M/S. LLOYD STEEL	MUMBAI		
		2. M/S. RASHTRIYA ISPAT NIGAM LTD	VIZAG		
		3. M/S. SAIL	MUMBAI		
		4. M/S. TISCO	JAMSHEDPUR		
		5. M/S. JINDAL STEEL & POWER LTD.	ORISSA		
		6. M/S. ESSAR STEEL INDIA LTD.	HAZIRA		
28	STEAM TRAPS	1. M/S. SPIRAX MARSHALL	PUNE	1. M/S.GESTER GMBH	GERMANY
		2. M/S. PENNANT ENGG. PVT. LTD.	PUNE		
		3. M/S. FORBES MARSHALL	PUNE		
29	MANUAL VALVES GATE / GLOBE / CHECK VALVES AND MO VALVES (CAST STEEL /FORGED STEEL)	1. M/S. BHEL, TRICHY	TRICHY		
		2. M/S. L&T VALVES	CHENNAI		

		LIMITED			
		3. M/S. FOURESS ENGINEERING	AURANGABAD & BANGALORE PLANT		
		4. M/S. KIRLOSKAR BROTHERS LTD.	PUNE		
		5. M/S. KSB LTD	COIMBATORE		
		6. M/S. NICO SCHUBERT & SULZER LTD.	MUMBAI		
		7. M/S.PRECISION ENGINEERING CO. (ORNATE GROUP)	CHENNAI		
		8. M/S. LEADER VALVE	JALANDHAR		
		9. M/S. FORBES MARSHALL PVT. LTD.	PUNE		
		10. M/S. BDK	HUBLI		
		11. M/S. STEEL STRONG VALVES	MUMBAI		
		12. M/S SHRI CHAMUNDA VALVES PVT. LTD.	AHMEDABAD		
		13. M/S. PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	BARODA		
		14. M/S. ADVANCE VALVES, NOIDA	NOIDA		
30	ANGLE GLOBE VALVE/ BLOWDOWN VALVES	1. M/S INDITECH VALVES PVT. LTD	PUNE		
		2. M/S. ASSOCIATED TOOLING	KOLKATA		
31	BALL VALVES	1. M/S. L&T VALVES LIMITED	CHENNAI	1. M/S. VANATOME	FRANCE
		2. M/S. MICROFINISH, (BDK)	HUBLI	2. M/S. PARKER	UK
		3. M/S. HYD AIR	MUMBAI	3. M/S. VELAN S.A.S.	FRANCE
		4. M/S. AKAY INDUSTRIES	HUBLI		
32	CONTROL VALVES	1. M/S. IL, PALAKKAD	PALAKKAD		
		2. M/S. R.K. CONTROLS	MUMBAI		
		3. M/S. MIL KSB CONTROLS LIMITED	PALAKKAD		
		4. M/S. VALFLOW,	AHMEDABAD		

		(M/S VALTEK)			
		5. M/S. SAMSONS CONTROL PVT., LTD.	THANE		
		6. M/S. FISHER SANMAR LIMITED	CHENNAI		
		7. M/S. FOURESS	BANGALORE		
		8. M/S. PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	BARODA		
33	BUTTERFLY VALVES	1. M/S. L&T VALVES LIMITED	COIMBATORE		
		2. M/S. FISHER SANMAR	CHENNAI		
		3. M/S. FOURESS	BANGALORE		
		4. M/S. PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	BARODA		
		5. M/S. INTERVALVE	PUNE		
		6. M/S. KBL	PUNE		
		7. M/S. CRANE PROCESS FLOW TECHNOLOGIES	PUNE		
		8. M/S. IL	PALGHAT		
34	DIAPHRAGM VALVES	1. M/S. BDK	HUBLI		
		2. M/S. CRANE PROCESS FLOW TECHNOLOGIES	PUNE		
		3. M/S. IL	PALGHAT		
		4. M/S. CHEM TECH VALVES	MUMBAI		
		5. M/S. ALFA LAVAL SAUNDERS	PUNE		
35	CHECK VALVES (WATER / AIR SERVICE) - TUBE VALVES			1. M/S. PARKER	UK
				2. M/S. SWAGELOK	USA
36	CHECK VALVES (OIL SERVICE)	1. M/S. BOSCH REXROTH	MUMBAI		
		2. M/S. VICKERS	MUMBAI		
37	AIR RELEASE VALVES	1. M/S. SPIRAX MARSHALL / M/S. FORBES MARSHALL	PUNE	1. M/S. ARMSTRONG INTERNATIONAL	UK

38	SAFETY RELIEF VALVES(WATER/AIR SERVICES)	1. M/S. BHEL	TRICHY	1. M/S. DRESSER CONSOLIDATED	USA
		2. M/S. TYCO SANMAR LTD	CHENNAI	2. M/S.WEIR VALVES	FRANCE
		3. M/S. MAZDA LTD.	AHMEDABAD		
		4. M/S. PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	LIMITED		
		5. M/S. WEIR ENGG. SERVICES(I) LTD	INDIA		
		6. M/S. SEMPELL INDIA PVT. LTD.	PUNE		
		7. M/S. IL	PALGHAT		
		8. M/S. FAINGER LESSER VALVES (P) LTD.	PUNE		
39	RELIEF VALVES (OIL SERVICE)	1. M/S. BOSCH REXROTH	MUMBAI		
40	RELIEF VALVES (CROSS PORT) - WATER SERVICE			1. M/S. CIRCLESEAL	USA
41	RELIEF VALVES (TUBE END)			1. M/S. PARKER	UK
				2. M/S. SWAGELOK	USA
42	VACUUM RELIEF VALVES	1. M/S. NIRMAL INDUSTRIES	MUMBAI		
43	PRESSURE REDUCING VALVES(EXCEPT OIL SERVICE)	1. M/S. DEWARANEE MCNCIL	CALCUTTA	1. M/S. CONCOA	USA
		2. M/S. INDIAN OXYGEN LTD.	MUMBAI		
		3. M/S. MAZDA LTD	AHMEDABAD		
		4. M/S. BALDOTA VALVES & FITTINGS	MUMBAI		
		5. M/S. J N MARSHALL	PUNE		

		6. M/S. NIRMAL INDUSTRIES	MUMBAI		
44	PRESSURE REDUCING VALVES (OIL SERVICE)	1. M/S. BOSCH REXROTH	MUMBAI		
45	FLOW CONTROL VALVES (OIL SERVICE)	1. M/S. BOSCH REXROTH	MUMBAI	1. M/S. PARKER	UK
46	MSIV (MAIN STEAM ISOLATION	1. M/S. FORBES MARSHALL PVT. LTD.	PUNE	1. M/S. HOPKINSONS LTD.	UK
				2. M/S. VELAN SA	FRANCE
				3. M/S. CCI SULZER	SWITZERL AND
				4. M/S. SEMPELL	GERMANY
47	MAIN STEAM RELIEF VALVES			1. M/S. WEIR POWER & INDUSTRIAL	FRANCE
				2. M/S. CCI SULZER VALVES	GERMANY
48	ATMOSPHERIC STEAM DISCHARGE VALVE (ASDV) AND CONDENSER STEAM DUMP VALVE (CSDV)	1. M/S.KSB MIL CONTROLS LIMITED		1. M/S. CCI SULZER	GERMANY
		2. M/S. IL, PALGHAT (INSTRUMENTATIO N LTD.)	PALGHAT	2. M/S. WEIR POWER AND INDUSTRIAL	FRANCE
				3. M/S. DANFOSS SOCIA	ITALY
49	BOILER FEED PUMPS	1. M/S. KSB	PUNE	1. M/S. CLYDE UNION	UK
		2. M/S. FLOWSERVE INDIA	CHENNAI	2. M/S. TERMOMECCANICA POMPE (TMP)	ITALY
				3. M/S. KSB	GERMANY
50	AUXILIARY BFP	1. M/S. KSB	PUNE	1. M/S. TERMOMECCANICA POMPE (TMP)	ITALY
		2. M/S. KBL (KIRLOSKAR EBARA	PUNE		

		PUMPS)			
		3. M/S. FLOWSERVE INDIA	CHENNAI		
51	FEED WATER HEATERS	1. M/S. BHEL	BHOPAL		
		2. M/S. L & T	MUMBAI		
		3. M/S. HPVP	VIZAG		
		4. M/S. GODREJ	MUMBAI		
		5. M/S. ISGEC	YAMUNANAGAR		
52	DEAERATOR AND STORAGE TANK	1. M/S. BHEL	TRICHY		
		2. M/S. HPVP	VIZAG		
		3. M/S. L & T	HAZIRA		
		4. M/S. GEA ENERGY (M/S. BGR)	CHENNAI		
53	TANKS & PRESSURE VESSELS	1. M/S. HPVP	VIZAG		
		2. M/S. GANSONS LTD.	NAGPUR		
		3. M/S. GODREJ & BOYCE	MUMBAI		
		4. M/S. IAEC INDIA LTD	CHENNAI		
		5. M/S. ISGEC	YAMUNANAGAR		
		6. M/S. L & T	MUMBAI		
		7. M/S. LLOYD STEEL	MUMBAI		
		8. M/S. NATIONAL HEAVY ENGINEERING CORPORATION LTD.	PUNE		
		9. M/S. RAJ ENGINEERING CO.	MUMBAI		
		10. M/S. SAURASHTRA ENGINEERING	MUMBAI		
		11. M/S. SHAKTI HI TECH.	CHENNAI		
		12. M/S. VIVIDH HI-FAB	BARODA		
		13. M/S. WIL	WALCHANDNAGAR		
		14. M/S. ANUP ENGG CO.	AHMEDABAD		
		15. M/S. GEA BGR	CHENNAI		

		ENERGY			
		16. M/S. NEW AGE FAB. TECH. PVT. (FABTECH) LTD.	SURAT		
		17. M/s. INDUSTRIAL EQUIPMENT PVT. LTD.	SHIL PHATA, THANE		
		18. M/S. ISHAN EQUIPMENTS PVT. LTD.	VADODARA		
54	HEAT EXCHANGERS (Shell and tube type)	1. M/S. GODREJ & BOYCE	MUMBAI		
		2. M/S. BHEL	TRICHY		
		3. M/S. HPVP	VIZAG		
		4. M/S. GR ENGINEERING	MUMBAI		
		5. M/S. L&T	MUMBAI		
		6. M/S. ISGEC	YAMUNANAGAR		
		7. M/S. WIL	WALCHANDNAGAR		
		8. M/S. LAXMI ENGINEERING INDUSTRIES (BHOPAL) PVT. LTD.	BHOPAL		
		9. M/S. NEW AGE FAB. TECH. PVT. (FABTECH)LTD.	SURAT		
55	PLATE TYPE HEAT EXCHANGERS	1. M/S. ALFA - LAVAL	PUNE		
		2. M/S. IDMC	ANAND		
		3. M/S. APV	CALCUTTA		
		4. M/S. GEA ECOFLEX INDIA PVT. LIMITED	PUNE		
	-	5. TRANTER	PUNE		
	-	6. KELVION INDIA PVT. LTD	PUNE		
56	CENTRIFUGAL PUMPS	1. M/S. AKAY INDUSTRIES	HUBLI	1. M/S. WEIR PUMPS	UK
		2. M/S. BPCL	NAINI		
		3. M/S. KBL	PUNE		
		4. M/S. SULZER PUMPS LTD	NAVI MUMBAI		
		5. M/S. KSB	PUNE		
		6. M/S. MATHER & PLATT	PUNE		

		7. M/S. WORTHINGTON	CALCUTTA		
57	SUBMERSIBLE PUMPS FOR NON ACTIVE DRAINAGE SYSTEM.	1. M/S. KBL	PUNE		
		2. M/S. KISHOR PUMP	PUNE		
		3. M/S. SU PUMP	MUMBAI		
		4. M/S. MBH PUMPS (GUJ.) PVT. LTD.	AHMEDABAD		
		5. M/S. DARLING PUMP	INDORE		
58	POSITIVE DISPLACEMENT PUMPS	1. M/S. ROTO PUMPS	DELHI		
		2. M/S. UT PUMPS AND SYSTEMS PVT. LTD.	FARIDABAD		
59	RUBBER EXPANSION JOINTS	1. M/S. APHRODITE POLYPRENE PVT. LTD. (APPL)	KOLKATA		
		2. M/S. CORI	CHENNAI		
		3. M/S. D. WREN	KOLKATA		
60	ORIFICE PLATE ASSEMBLIES	1. M/S. TEMP TECH	MUMBAI		
		2. M/S. MINCO	GOA		
		3. M/S. IL	PALGHAT		
		4. M/S. STAR MECH	PUNE		
		5. M/S. SGPE	AMBERNATH		
		6. M/S. DYNAFLUID VALVES AND FLOW CONTROLS PVT. LTD.	BELGAUM		
		7. M/S. HYDROPNEUMATICS PVT. LTD.	GOA		
		8. M/S. VINIR ENGG PVT.LTD	BANGALORE		
		9. M/S. M G M FORGING	HUBLI		
61	AIR CONDITIONING & VENTILLATION	1. M/S. BLUE STAR LTD.	MUMBAI		
		2. M/S. ANDREW	KOLKATA		

		YULE LTD.			
		3. M/S. LLOYDS LTD.	DELHI		
		4. M/S. AVPL	KUNDLI, HARYANA		
62	CHEMICAL DOSING SYSTEM	1. M/S. ION EXCHANGE (INDIA) LTD.	NAVI MUMBAI		
		2. M/S. THERMAX LIMITED	PUNE		
		3. M/S. POSITIVE METERING PUMPS (I) PVT LTD	NASHIK		
63	SGBD POLISHING UNITS.	1. M/S. ION EXCHANGE (INDIA) LTD.	NAVI MUMBAI		
		2. M/S. THERMAX LIMITED.	PUNE		
		3. M/S. DRIPLEX WATER ENGINEERING INTERNATIONAL LIMITED.	DELHI		
		4. M/S. DOSHION	AHMEDABAD		
64	CRANES & HOISTS	1. M/S. WMF CRANES LTD	MUMBAI		
		2. M/S. FURNACE AND FOUNDRY ENGG. CO. LTD.	MUMBAI		
		3. M/S UNIQUE INDUSTRIAL HANDLER PVT. LTD.	MUMBAI		
		4. M/S MUKAND LTD.	MUMBAI		
		5. M/S ELECTROMECH MATERIAL HANDLING SYSTEMS (I) LTD.	PUNE		
		6. M/S. ANUPAM INDUSTRIES LTD.	ANAND, GUJARAT		
		7. M/S. SAFEX INDUSTRIES LTD.	AHMEDABAD.		
		8. M/S. BRADY AND MORRIS ENGG.	KHEDA, GUJARAT		
65	FIRE DETECTION AND	1. M/S. KIDDE	DELHI		

	SUPPRESSION SYSTEM				
		2. M/S. TECHNICO	KOLKATA		
		3. M/S. TYCO	MUMBAI		
		4. M/S. NEW FIRE CO.	MUMBAI		
		5. M/S. MATHER & PLATT (MPF SYSTEM)	MUMBAI		
		6. M/S. STERLING & WILSON	MUMBAI		
66	SNUBBERS AND SWAY BRACES			1. M/S. LESIGA	GERMANY
				2. M/S. CARPENTER AND PETTARSON	UK
				3. M/S. DAMAN JARRET	FRANCE
				4. M/S. NPS IBERICA	SPAIN
				5. M/S. PIPE SUPPORT SYSTEMS GMBH INTERNATIONAL	GERMANY
				6. M/S. QUIRI	FRANCE
				7. M/S. PACIFIC SCIENTIFIC	USA
B	**ELECTRICAL ITEMS**				
1	ISOLATED PHASE BUSDUCT (IPBD)	1. M/S. REEP INDUSTRIES	CHENNAI		
		2. M/S. C&S ELECTRIC	DELHI		
		3. M/S. BHEL	HARIDWAR		
2	GENERATOR CIRCUIT BREAKER (GCB)	1. M/S. ABB	MUMBAI	1. M/S. ALSTOM GRID SAS	FRANCE
		2. M/S. HITACHI	DELHI		
3	MCCS	1. M/S. SIEMENS	MUMBAI		
		2. M/S. L&T	MUMBAI		
		3. M/S. SCHNEIDER	AHMEDABAD		
4	ELEVATORS	1. M/S. OTIS	MUMBAI		
		2. M/S. KONE (OLYMPUS)	DELHI		
		3. M/S. TECHNO INDUSTRIES LTD	AHMEDABAD		
		4. M/S. SCHINDLER	NOIDA		
5	AC & DC	1. M/S. SIEMENS	MUMBAI		

	DBS				
		2. M/S. L&T	MUMBAI		
		3. M/S. SCHNEIDER	AHMEDABAD		
		4. M/S. C&S	NOIDA		
		5. M/S. GE POWER	NOIDA		
6	LV POWER (XLPE INSULATED FRLS PVC SHEATHED) CABLES	1. M/S. NICCO CABLES	KOLKATA		
		2. M/S. UNIVERSAL CABLES	SATNA		
		3. M/S. PARAMOUNT CABLE COORPORATION	DELHI		
		4. M/S. HAVELL'S INDIA	ALWAR		
		5. M/S.FINOLEX CABLES, URSE	PUNE		
		6. M/S. POLYCAB CABLES	DAMAN		
		7. M/S. UNI FLEX CABLES	GUJARAT		
		8. M/S. KEI	AHMEDABAD		
		9. M/S.TORRENT CABLES	AHMEDABAD		
		10. M/S. RAVIN CABLES, MARKAL	PUNE		
		11. M/S. RALLISON ELECTRICALS, CHOPANKI	BHIWADI		
7	CONTROL CABLES	1. M/S. NICCO CABLES	KOLKATTA		
		2. M/S. UNIVERSAL CABLES	SATNA		
		3. M/S. FINOLEX CABLES,URSE	PUNE		
		4. M/S. POLYCAB CABLES	DAMAN		
		5. M/S. UNI FLEX CABLES	GUJARAT		
		6. M/S. KEI	ALWAR		
		7. M/S.TORRENT CABLES	AHMEDABAD		

		8. M/S. RAVIN CABLES, MARKAL	PUNE		
		9. M/S. RADIANT CABLES	HYDERABAD		
8	FIRE BARRIER	1. M/S. SIGNUM (FOR BOTH INDOOR AND OUTDOOR)	NAGPUR		
		2. M/S. NAVAIR (FOR BOTH INDOOR AND OUTDOOR)	DELHI		
		3. M/S. MULTIKIL (FOR INDOOR ONLY)	VADODARA		
9	FIRE BREAKS	1. M/S. SIGNUM (FOR INDOOR ONLY)	NAGPUR		
		2. M/S. VIJAI FIRE (FOR BOTH INDOOR AND OUTDOOR)	MUMBAI		
10	CABLE TRAYS AND ACCESSOTIRS	1. M/S. ASIAN ANCILIARIES	MUMBAI		
		2. M/S. DOLPHIN ENGG	ANAKAPALLE, AP		
		3. M/S. INDIANA CABLE TRAYS	MUMBAI		
		4. M/S. METALLEMS	MUMBAI		
		5. M/S. TECHNOFAB	NASHIK		
		6. M/S. PATNY SYSTEMS	HYDERABAD		
11	LIGHTING FIXTURES	1. M/S. BAJAJ	MUMBAI		
		2. M/S. PHILLIPS	MUMBAI		
		3. M/S. CROMPTON GREAVES	MUMBAI		
		4. M/S. WIPRO	MUMBAI		
12	STRUCTURAL STEEL INCLUDING ROUNDS IS 2062 GRD A 40.000 MM	1. M/S. STEEL AUTHORITY OF INDIA LTD.	MUMBAI		
		2. M/S. RASHTRIYA ISPAT NIGAM LTD.	VIZAG		
		3. M/S. TATA STEEL LIMITED	MUMBAI		
13	LUGS	1. M/S. DOWELL	MUMBAI		
		2. M/S. 3D	KOLKATA		
		3. M/S. COMET	DELHI		

14	ANCHOR FASTENERS	1. M/S. HILTI	MUMBAI		
		2. M/S. ANCHOR	MUMBAI		
		3. M/S. DASH	DELHI		
		4. M/S. ARISTOCRAT	BANGALORE		
15	FLAME PROOF LIGHTING FIXTURES	1. M/S. BALIGA	CHENNAI		
		2. M/S. FLAME PROOF CONTROL GEAR	MUMBAI		
		3. M/S. PROMPT ENGINEERING WORKS	MUMBAI		
16	415 V MOTORS	1. M/S. KEC LTD.	BANGALORE		
	(GREATER THAN 50 KW)	2. M/S. CROMPTON GREAVES LTD.	MUMBAI		
		3. M/S. ABB LTD.	MUMBAI		
		4. M/S. SIEMENS LTD.	MUMBAI		
		5. M/S. BHARAT BIJLEE LTD.	MUMBAI		
		6. M/S. ALSTOM	MUMBAI		
17	415 V MOTORS	1. M/S. KEC LTD.	BANGALORE		
	(LESS THAN 50 KW)	2. M/S. CROMPTON GREAVES LTD.	MUMBAI		
		3. M/S. ABB LTD.	MUMBAI		
		4. M/S. SIEMENS LTD.	MUMBAI		
		5. M/S. BHARAT BIJLEE LTD.	MUMBAI		
		6. M/S. ALSTOM INDIA LTD.	MUMBAI		
		7. M/S. REMI UDYOG P. LTD (UP TO 30 KW ONLY FOR NON CRITICAL APPLICATIONS LIKE EXHAUST FANS FOR ROOMS, OFFICES, DEWATERING PUMPS AND DRIVE MOTORS FOR ISOLATORS……)	MUMBAI		
		8. M/S. LAXMI HYDRAULICS PVT. LTD.	SOLAPUR		

18	6.6 KV MOTORS	1. M/S. BHEL	BHOPAL		
		2. M/S. CROMPTON GREAVES LTD.	MUMBAI		
		3. M/S.ABB (UP TO 2000 KV) LTD.	MUMBAI		
		4. M/S.ALSTOM (UP TO 950 KV) INDIA LTD.	MUMBAI		
		5. M/S.KEC LTD.	BANGALORE		
19	TERMINAL BLOCKS	1. M/S. ELMEX CONTROLS P. LTD.	VADODARA		
		2. M/S. CONNECT WELL INDUSTRIES PVT. LTD.	DOMBIVALI		
20	HV FUSES IN IPBD			1. M/S. SADTEM	FRANCE
21	GI COATED EARTHING MATERIAL COMPRISING OF FOLLOWING:				
21a)	EARTHING FLAT GALVANIZED STEEL (GS FLAT)	1. M/S. RUKMANI ELECTRICALS & COMPONENT PVT.LTD.	KOLKATA		
		2. M/S. PREMIER POWER PRODUCT	KOLKATA		
21b)	EARTHING FLAT GALVANIZED IRON (GI FLAT)	1. M/S. RUKMANI ELECTRICALS & COMPONENT PVT.LTD.	KOLKATA		
		2.M/S. PREMIER POWER PRODUCT.	KOLKATA		
21c)	EARTHING ELECTRODES (MILD STEEL 40MM DIA 3.5M)	1. M/S. RUKMANI ELECTRICALS & COMPONENT PVT.LTD.	KOLKATA		
		2. M/S. PREMIER POWER PRODUCT.	KOLKATA		
21 d)	GI FLEXIBLE WIRE	1. M/S. P S ELECTRICAL	KOTA		
21 e)	FLEXIBLE GI CONDUIT	1. M/S. P S ELECTRICAL	KOTA		
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	-				
C	**CONTROL & INSTRUMENT**				

	ATION ITEMS				
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1	SS TUBING	1. M/S. NUCLEAR FUEL COMPLEX, HYDERABAD.	Hyderabad	1.M/S SANDVIK, SWEDEN	Sweden
		2. M/S. RATNAMANI METALS & TUBES LTD.	Ahmedabad	2.M/s.Finetubes UK	UK
		3. M/S REMI Edelstahl Tubular Limited	Mumbai		
2	SS PIPE and SS PIPE FITTINGS	1. M/S. NUCLEAR FUEL COMPLEX, HYDERABAD	Hyderabad		
		2. M/S ARVIND PIPES AND FITTINGS IND. PVT. LTD., MUMBAI	Mumbai		
		3. M/S. CHOKSI TUBE CO. LTD.			
		4. M/S COMMERCIAL SUPPLYING AGENCY, MUMBAI	Mumbai		
		5. M/S. EBY FASTENERS,TALOJA	Taloja		
		6. M/S. CENTRAL STEEL CORPORATION , MUMBAI	Mumbai		
3	CS PIPE	1. M/S ARVIND PIPES AND FITTINGS IND. PVT. LTD., MUMBAI	Mumbai		
		2. M/S. INDIAN SEAMLESS LTD.			
		3. M/S. HYDAIR ENGG WORKDS, MUMBAI	Mumbai		
		4. M/S. CENTRAL STEEL CORPORATION , MUMBAI	Mumbai		
		5. M/S.LLOYD ENGG PVT LTD , NAVI MUMBAI	Mumbai		
4	CS PIPE FITTINGS	1. M/S ARVIND PIPES AND FITTINGS IND. PVT. LTD., MUMBAI	Mumbai		
		2. M/S. EBY FASTENERS, MUMBAI	Mumbai		
		3. HYDAIR MUMBAI	, Mumbai		
		4. CENTRAL STEEL CORPORATION , MUMBAI	Mumbai		
		5. LLOYD ENGG PVT LTD , NAVI MUMBAI	Mumbai		

5	ADAPTORS	1. M/S ASTEC VALVES & FITTINGS PVT. LTD.	Mumbai.		
		2. M/S EXEL HYDRO PNEUMATIC, MUMBAI	Mumbai		
		3. M/S. TEMPTECH, MUMBAI	Mumbai		
6	COPPER TUBING	1. M/S MULTIMETALS, KOTA	Kota		
		2. M/S RAJCO METAL INDUSTRIES PVT. LTD., MUMBAI	Mumbai		
		3. NATIONAL METAL MUMBAI	Mumbai		
		4. M/S.HINDUSTAN STEEL & METAL WORKS, MUMBAI	Mumbai		
7	SS TUBE FITTINGS			1.M/S SWAGELOK CO., USA	USA
				2.M/s. PARKER HANNIFIN U.K.	UK
				3.M/S.CREXIMCO, USA	USA
8	BRASS TUBE FITTINGS	1. M/S.FLUID TECH, MUMBAI	Mumbai	1. M/s. HERION AND NORGEN ,	
		2. M/S ASCO INDIA LTD, CHENNAI	Chennai	2. M/s. HAHN& SOUR ,	
		3. M/S.V.R.ENGINEERING, MUMBAI	Mumbai	3. M/s. VICKERS , UK	UK
		4. PRICISION INDUSTRIES MUMBAI	Mumbai		
		5. M/S.SAMTA WELDING WORKS			
		6. M/S.MULTIMETAL, BARODA	Ba, Roda		
		7. M/S HYD-AIR ENGG. WORKS, MUMBAI	Mumbai		
9	AIR ACCUMULATOR TANKS	1. M/S. DCMS ENGG. CO. MUMBAI.	Mumbai		
		2. M/S NATIONAL ENGG. CO., BARODA	Mumbai		
10	CATCH POTS	1. M/S. DCMS ENGG. CO. MUMBAI.	Mumbai		
		2. M/S COLDWELD ENGINEERS PVT. LTD			
11	BRASS PIPE FITTINGS	1. M/S ASTEC VALVES & FITTINGS PVT. LTD.	Mumbai		
		2. M/S EXEL HYDRO PNEUMATIC, MUMBAI	Mumbai		
		3. M/S. FLUIDCONTROLS			

12	BRASS CHECK VALVES	1. M/S HYD-AIR ENGG. WORKS, MUMBAI	Mumbai		
		2. M/S ASTEC VALVES & FITTINGS PVT. LTD	Mumbai		
		3. M/S EXEL HYDRO PNEUMATIC, MUMBAI	Mumbai		
		4. M/S.ANMOL FLUID CONNECTORS, MUMBAI	Mumbai		
13	AIR FILTER PRESSURE REGULATORS	1. M/S SHAVONORGREN INDIA PVT. LTD., MUMBAI	Mumbai		
		2. M/S PLACKA INST			
		3. M/S. SMC PNEUMATICS, NOIDA. /CHENNAI	Mumbai		
14	SS ISOLATION NEEDLE VALVES	1. M/S HYD-AIR ENGG. WORKS, MUMBAI	Mumbai	1. M/S. SWAGELOK CO., USA	USA
		2. M/S ASTEC VALVES & FITTINGS PVT. LTD.	Mumbai	2.M/s. PARKER HANNIFIN U.K.	UK
		3. M/S. CHEMTROL ENGINEERING, MUMBAI.	Mumbai		
		4. M/S. FLUID CONTROLS MUMBAI	Mumbai		
		5. M/S. PANAM ENGINEERS LIMITED, MUMBAI	Mumbai		
		6. Excel Hydro Pneumatic	Mumbai		
15	1/2" C.S. VALVES	1. M/S. BDK LEADER		1. M/S. SWAGELOK CO. U.S.A.	USA
		2. M/S. R.K.ENGG MUMBAI	Mumbai		
		3. M/S HYD-AIR ENGG. WORKS, MUMBAI	Mumbai		
		4. M/S ASTEC VALVES & FITTINGS PVT. LTD.	Mumbai		
		5. M/S.PROTOLINA INSTRUMENTS, MUMBAI	Mumbai		
		6. M/S.FOURESS			
16	PACKED SS 3 VALVE MANIFOLDS	1. M/S. HYD-AIR ENGG. WORKS, MUMBAI	Mumbai	1. M/S. SWAGELOK CO. U.S.A.	USA
		2. M/S ASTEC VALVES & FITTINGS PVT. LTD.	Mumbai	2.M/s. PARKER HANNIFIN U.K.	
		3. M/S. EXCEL HYDRO MUMBAI	Mumbai		
		4. M/S.PANAM ENGINEERS LIMITED,	Mumbai		

		MUMBAI			
17	PACKED 5 VALVE MANIFOLDS FOR HIGH PRESSURE & HIGH TEMP. APPLICATION	1. M/s.Hyd-air Engineering Works, Mumbai	Mumbai	1. M/S. PARKER HANNIFIN CORP. U.K.	UK
		2. M/S ASTEC VALVES & FITTINGS PVT. LTD.	Mumbai	3.M/S. SWAGELOK CO. U.S.A.	USA
		3. M/s.Placa Instruments, Chennai	Chennai	4.M/S. THOMSON VALVES, U.K.	UK
		4. M/s. Panam Engineers Limited, Mumbai.	Mumbai	5.M/S.ANDERSON GREENWOOD, U.K.	UK
18	BRASS NEEDLE VALVES	1. M/S HYD-AIR ENGG. WORKS, MUMBAI	Mumbai		
		2. M/S ASTEC VALVES & FITTINGS PVT. LTD.	Mumbai		
		3. M/S. EXCEL HYDRO MUMBAI	Mumbai		
		4. M/S. R.K.CONTROLS INSTR., THANE	Mumbai		
19	SS BOURDON TUBE PRESSURE GAUGES	1. M/S. BAUMER TECHNOLOGIES INDIA PVT LTD		1. M/S. ASHCROFT, U.K.	UK
		2. M/S. PRECISION INSTRUMENTS, MUMBAI.	Mumbai		
		3. M/S. GAUGES BOURDON (INDIA) PVT. LTD.			
		4. M/S. A.N.INSTRUMENTS, KOLKATA.	Mumbai		
		5. M/S. H. GURU (PG & DP), KOLKATA	Mumbai		
		6. M/S.SWITZER (DGP), CHENNAI	Chennai		
		7. M/S.PRICOL, CHENNAI	Chennai,		
20	DIFFERENTIAL PRESSURE GAUGES	1. M/S. BAUMER TECHNOLOGIES INDIA PVT LTD		1. M/S. ASHCROFT, U.K.	UK
		2. M/S. PRECISION INSTRUMENTS, MUMBAI.	Mumbai		
		3. M/S. GENERAL INSTRUMENTS, MUMBAI.	Mumbai		
		4. M/S. A.N.INSTRUMENTS,	Mumbai		

		KOLKATA.			
		5. M/S. H. GURU (PG & DP), KOLKATA	Mumbai		
		6. M/S. SWITZER (DGP), CHENNAI	Chennai		
		7. M/S. PRICOL, CHENNAI	Chennai		
21	TEMPERATURE GAUGES	1. M/S. BAUMER TECHNOLOGIES INDIA PVT LTD			
		2. M/S . BELLS CONTROLS, MUMBAI.	Mumbai		
		3. M/S. GENERAL INSTRUMENTS, MUMBAI.	Mumbai		
		4. M/S. A.N.INSTRUMENTS, KOLKATA.	Mumbai		
		5. M/S.H. GURU (PG & DP), KOLKATA	Mumbai		
		6. M/S.PRICOL, CHENNAIMUMBAI	Chennai, Mumbai		
22	LEVEL GAUGES	1. M/S. PUNE TECHTROL, PUNE	Pune	M/s K	
		2. M/S . CHEMTROL ENGG. LTD., MUMBAI	Mumbai		
		3. M/S. ASIAN INDUSTIAL VALVES & INSTRUMENTS, CHENNAI	Chennai		
		4. M/S. K-TECH ,ING - ENGG CO. (MAGNETIC)			
		5. M/S. WIKA PUNE (MAGNETIC)	Pune		
		6. M/S. CRYSTAL INSTRUMENTS, MUMBAI	Mumbai		
		7. M/S. LEVCON INSTRUMENTS, KOLKATA	Kolkata		
23	PRESSURE SWITCHES & DP SWITCHES	1. M/S SWITZER INSTR LTD., CHENNAI,	Chennai,	1.M/s.DWYER INSTRUMENTS, U.K.	UK
		2. M/S. PRECISION IINDUSTRIES, MUMBAI. (FOR ASHCROFT MAKE)		2.M/s. ASHCROFT, U.K.	UK
		3. M/S.INDFOSS		3.M/s. SOR, USA	USA
		4. M/S.SWITZER (DPG), CHENNAI	Chennai	4.M/s.KDG, MOBREY, UK	UK
		5. M/S. VERMA TRAFAG.		5.M/s. ASCO, USA	USA
24	TEMPERATURE SWITCHES	1. M/S GOA INSTRUMENTS CONSORTIUM,	Mumbai		

		MUMBAI			
		2. M/S. SWITZER			
25	FLOW SWITCHES	1. M/S. KROHNE MARSHAL LTD., PUNE.	Mumbai		
		2. M/S. INSTRUMENTATION ENGRS., HYDERABAD	Mumbai		
		3. M/S GENERAL INSTS MUMBAI.	Mumbai.		
26	LIMIT SWITCHES	1. M/S BHARTIYA CUTLER & HAMMER , MUMBAI / CHENNAI	Chennai	1. M/s. MICROSWITCH USA	USA
		2. M/S.KAYCEE INDUSTRIES		2. M/s.HONEY WELL, USA	USA
		3. M/S.JAIBALAJI, CHENNAI	Chennai	3. M/s. SNAPLOC, USA	USA
27	LEVEL SWITCHES	1. M/S. TRANSDUCERS & CONTROL PVT. LTD., HYDERABAD	Hyderabad	1. M/S. KDG MOBREY U.K.	UK
		2. M/S. CHEMTROL ENGG.LTD.,MUMBAI	Mumbai		
		3. M/S. SBEM PUNE	Pune		
		4. M/S. SWITZER (DPG) CHENNAI	Chennai		
		5. M/S. D.K. INSTRUMENTS, KOLKATA	Mumbai		
		6. M/S. LEVCON INSTRUMENTS, KOLKATA	Kolkata		
		7. M/S. V. AUTOMAT	Delhi		
28	ELECTRONIC TRANSMITTERS	1. M/s. Baldota Controls & Equipments Pvt. Ltd., Mumbai (for SMAR MAKE)	MUMBAI	1. M/S SMAR, BRAZIL	
		2. M/S. ABB LIMITED, HARYANA	HARYANA	2. M/s ABB	JAPAN
				3. M/s Seimens, Germany	
		3. M/S. EMERSON, BARODA	BARODA		
		4. M/S. HONEYWELL, GURGAON	GURGAON	4. M/s HONEYWELL	
		5. M/S. ENDRESS + HAUSER (INDIA) PVT. LTD. , MUMBAI	MUMBAI	5. Endress & Hauser	
		6. M/s YOKOGAWA INDIA	MUMBAI	6. M/S. YOKOGAWA	
29	TEMP. TRANSMITTERS	1. M/S. MASIBUS PROCESS INST. GANDHINAGAR.	Gandhinagar.	1. M/S. YOKOGAWA	
		2. M/S.Astron Mumbai	Mumbai	2. M/s PR Electronics, Denmark	
		3. M/S. Emerson Process (I) Ltd. .	Mumbai		
		4. M/s ABB	Bhopal		

30	E/A CONVERTER	1. M/S SHREYAS INST. PVT. LTD., CHENNAI	Chennai	1. M/s YOKOGAWA	
		2. M/S. Emerson Process (I) Ltd. (for FISHER make) .			
		3. M/s Fairchild	Mumbai		
31	ELECTO-PNEUMATIC Converter		Mumbai		
32	RTDs	1. M/S. TEMP TECH, MUMBAI	Mumbai	M/s Ericat, France	
		2. M/S. GEN. INSTRUMENTS CONSORTIUM, MUMBAI.(GEN PURPOSE) / CHENNAI	Mumbai	M/s CMR, France	
		3. M/S. TEMPSENS UDAIPUR	Udaipur		
		4. M/S. IL, KOTA	Kota		
		5. M/S. DETRIV, MUMBAI	Mumbai		
		6. M/s ABB	Hariyana		
		7. M/s Emerson	Vadodara		
		8. M/s Endress & Hauser	Mumbai		
33	THERMOCOUPLES	1. M/S. TEMP TECH, MUMBAI	Mumbai	M/s Ericat, France	
		2. M/S. GEN. INSTRUMENT CONSORTIUM, MUMBAI / CHENNAI	Mumbai	M/s CMR, France	
		3. M/S TEMPSENS UDAIPUR	Udaipur		
		4. M/S. DETRIV, MUMBAI	Mumbai		
		5. M/S. IL, KOTA	Kota		
		6. M/s ABB	Hariyana		
		7. M/s Emerson	Vadodara		
		8. M/s Endress & Hauser	Mumbai		
34	JUNCTION BOXES & ACCESSORIES	1. M/S PYROTECH, UDAIPUR	Udaipur		
		2. M/S RELIABLE ELECTRICALS, MUMBAI.	Mumbai		
		3. M/S.INDUSTRIAL CONTROLS AND APPLIANCES, MUMBAI	Mumbai		
		4. M/S. ECIL, HYDERABAD	Hyderabad		
		5. M/S.JAISON-HUTCHISON, CHENNAI	Chennai		
		6. M/S.I.L., KOTA	Kota		
		7. M/S.BALIGA, CHENNAI	Chennai		

		9. M/S. RITTAL, BANGALORE	BANGALORE		
		10. M/S. BCH ELECTRIC, FARIDABAD	FARIDABAD		
		11. M/S. EMECON OCNTROLS PTVT. LTD., NEW DELHI	DELHI		
		12. M/S. EXPROTECTA, BARODA	BARODA		
		13. M/S. VISHWKARAMA, NEW DELHI	NEW DELHI		
35	TB & ACCESSORIES	1. M/S. CONNECTWELL MUMBAI.	Mumbai		
		2. M/S. PHOENIX INDIA NOIDA	Noida		
		3. M/S. WEIDMULLER INDIA BANGLORE.	Mumbai		
		4. M/S. ELMEX CONTROLS PVT. LTD., BARODA	Mumbai		
36	VIBRATION MONITORING SYSTEM FOR HT DRIVES	1. M/s. Meggit India Private Limited		1.M/S SCHENCK, GERMANY	GERMANY
		2. M/s. FORBES MARSHAL, PUNE	Pune	2.M/S.BENTLY NEVADA, GE USA	USA
		3. IRD Mechanalysis Limited	Mumbai	3.M/S SHINKAWA, JAPAN	JAPAN
37	H2 LEAK DETECTION SYSTEM	1. M/S . SUBTRONICS, MUMBAI	Mumbai	1. M/s. FIGARO JAPAN	JAPAN
		2. M/S. JB BODA B'lore	B'lore	2.M/s. BIELER +LANG GERMANY	GERMANY
		3. M/s. Ambetronics Engineers Pvt. Ltd., Mumbai	Mumbai		
		4 M/s Uniphos Envirotronic Pvt Ltd.	Umbergaon, Dist Valsad		
38	FEED WATER QUALITY ANLYZAR. (SWAS)	1. M/S. EMERSON PROCESS, MUMBAI	MUMBAI	1. M/s Meltor Toledo, USA	
				2. M/s Endress and Hauser, Germany	
		2. M/s. FORBES MARSHAL, PUNE	Pune	3. M/s Teledyne, USA	
		3. M/S. ORBIT TECHNOLOGY (SWAN, SWITZERLAND MAKE), HYDERABAD	HYDERABAD	4. M/s Hach, USA	
		4. M/s Steam Equipment Pvt. Ltd.	Pune		

39	SOLENOID VALVE	1. M/S. IL KOTA	Kota	1. M/s. VALCOR, U.S.A	USA
		2. M/s. ASCO,Chennai	Chennai	2.M/s. Segault, France	FRANCE
		3. M/s. Rotex, Vadodara	Vadodara		
40	LOCAL CONTROL PANELS (FLOOR MOUNTED TYPE)	1. M/S. INDUSTRIAL CONTROL & APPLIANCES, MUMBAI.	Mumbai		
		2. M/S KEAS CONTROLS , COIMBATORE	Coimbatore		
		3. M/S. RELIABLE ELECTRICALS MUMBAI	Mumbai		
		4. M/S. IL., KOTA	Mumbai		
		5. M/S.PYROTECH, UDAIPUR	Udaipu, R		
		6. M/S. ECIL, HYDERABAD	Hyderabad		
		7. M/S.KAIREL SWITCHGEAR	Switchgea		
		8. M/S.ELEC-MECH, MUMBAI	Mumbi		
		9. M/S.JAISON-HUTCHISON, CHENNAI	Chennai		
		10. M/S.SHIBSHAW INSTRUMENTS, CHENNAI	Chennai		
		11. M/S.PRAMAN INDUSTRIES, PUDUKOTAI (TAMIL NADU)	Pudukotai (Tamilnadu)		
41	HANDSWITCHES (PANEL MOUNTED COMPONENTS)	1. M/S KAYCEE, MUMBAI	Mumbai		
		2. M/S SEIMENS, MUMBAI	Mumbai		
		3. M/S. SALZER,COIMBATORE	Coimbatore		
		4. M/S. MOSS MAN(ENTECH)			
		5. M/S.LARSEN & TOUBRO			
42	PUSH BUTTONS	1. M/S BHARTIYA CUTLER HAMMER			
	(PANEL MOUNTED COMPONENTS)	2. M/S SEIMENS, MUMBAI	Mumbai		
		3. M/S. CONCORD, MUMBAI	Mumbai		
		4. M/S. TECHNIC, MUMBAI	Mumbai		

		5. M/S.CUTLER-HAMMER			
		6. M/S.KAYCEE			
		7. M/S.SALZER			
		8. M/S.BALIGA, CHENNAI	Chennai		
43	INDICATING METERS	1. M/S LEKTROLAB, MUMBAI	Mumbai		
	(PANEL MOUNTED COMPONENTS)	2. M/S MECO INSTRUMENTS, MUMBAI	Mumbai		
		3. M/s.ELECTRONET (LOOP POWERED)			
		4. M/S.TELETHERM, CHENNAI	Chennai		
		5. M/S.LECTROLAB, MUMBAI	Mumbai		
44	ANNUNCIATORS	1. M/S. APLAB, MUMBAI	Mumbai		
	(PANEL MOUNTED COMPONENTS)	2. M/S. IL, KOTA	Kota		
		3. M/S. ECIL, HYDERABAD	Hyderabad		
		4. M/S. INTELEC, PUNE	Pune		
		5. M/S. INSTA ALARM MUMBAI	Mumbai		
		6. M/S.TELETHERM, CHENNAI	Chennai		
		7. M/S. LECTROLAB, MUMBAI	Mumbai		
45	TERMINAL BLOCKS	1. M/S ELMEX, BARODA	Baroda	1. M/S WEID MULLAR, GERMANY	GERMANY
	(PANEL MOUNTED COMPONENTS)	2. M/S. CONNECT WELLS (DOMBIVLI), MUMBAI	Mumbai		
		3. M/S. PHOENIX INDIA	New Delhi		
46	RELAYS	1. M/S. PLA		1. M/s. KUNKE GERMANY	GERMANY
	(PANEL MOUNTED COMPONENTS)	2. M/S. LARSEN & TOUBRO			
		3. M/S. OEN			
		4. M/S. SIEMENS			
		5. M/s. ITI B'LORE	B'lore		
		6. M/s. OMRON			
		7. M/s. JYOTI INDUSTRIES BARODA	Baroda		
		8. M/s.	India		

		TELEMECHANIQUE (INDIA)			
47	LAMPS (CLUSTERED LED)	1. M/S. CONCORD		1. M/s. AGASTAT USA	USA
	(PANEL MOUNTED COMPONENTS)	2. M/S. SIEMENS			
		3. M/S. LARSEN & TOURBO			
		4. M/S. BHARATIYA CUTLER & HAMMER			
		5. M/S. ASEA, BANGALORE	Bangalore		
		6. M/s. TELEMECHANIQUE INDIA	India		
		7. M/s. OMRON			
		8. M/s. ECIL			
48	FUSES	1. M/S. LARSEN & TOUBRO			
	(PANEL MOUNTED COMPONENTS)	2. M/S. SIEMENS			
		3. M/s. GE POWER			
		4. M/s.BUSSMAN			
49	MCB	1. M/s INDO KOPP			
	(PANEL MOUNTED COMPONENTS)	2. M/s LEGRANDE (FORMERLY M/s MDS)			
		3. M/s.SEIMENS			
50	AVERAGING PITOT TUBES (ANNUBARS)	1. M/S. SWITZER, CHENNAI	Chennai		
		2. M/S. CHANDAK INSTRUMENTS, NAGPUR (FOR M/S.VERIS INC.USA MAKE)	Mumbai		
		3. M/s.Emerson process			
		4. M/S.FISHER ROSEMOUNT / M/S.DIETRICH	Mumbai		
51	PAPER LESS DIGITAL RECORDERS	1. M/s. CHINO LAXONS			
		2. M/s. EUROTHERM(DEL INDIA)	India		
52	ORIFICE PLATE ASSEMBLIES	1. M/s. IL-PALGHAT	Palghat		
		2. M/S. MINCO, GOA	Goa		

		3. M/S. TEMP TECH, MUMBAI	Mumbai		
		4. M/s. STARMECH, PUNE	Pune		
		5. M/s. SGPE, AMBERNATH	Ambernath		
		6. M/s. MICROPRECISION			
		7. M/s. GENERAL INSTRUMENTS, MUMBAI	Mumbai		
53	FLOW GLASSES	1. M/S.LEVCON, KOLKATA	Kolkata		
		2. M/S.PRATOLINA, MUMBAI	Mumba		
		3. M/s. ASIAN INDUSTRIES CHENNAI	Chennai		
		4. M/s. TRAC			
54	ULTRASONIC FLOW INSTRUMENTS	1. M/s.KHRONE MARSHAL		1.M/s.Thermo scientific USA	USA
		2. M/s. PANAMETRICS	Mumbai	2. M/s.Panametrics, U.S.A.	USA
				3. M/s. CONTROTRON	
		3. M/s. ELECTRONET PUNE (ABM CANADA)	Pune	4. M/S. POLISONIC, USA	USA
		4. M/s. E&H(I)			
		5. M/s.THERMO FISHER SCIENTIFIC NAVI MUMBAI	Mumbai		
		6. M/S. IOTAFLOW Systems Pvt. Ltd., New Delhi	Mumbai		
		7. M/S. THOSBRO, MUMBAI	MUMBAI		
		8. M/S. WAREE INSTRUMENTS, MUMBAI	MUMBAI		
		9. Adept Fluidyne	Pune		
		10. EIP Enviro, Noida (BM Tecnologie, Italy)	Noida		
55	MAGNETIC Level Guage with Transmitter / Switch and Level Guage	1. M/s. MAGNETROL	Mumbai		
		2. M/s. KTEK MUMBAI	Mumbai		
		3. M/s.WIKA PUNE (MAGNETIC)	PUNE		
		4. M/s. V.Automat & Instruments Pvt. Ltd., New Delhi	Mumbai		
		5. M/S. WEKA, (FORBES MARSHAL) PUNE	PUNE		

56	ULTRASONIC LEVEL INSTRUMENTS	1. M/s. SBEM PUNE	Pune		
		2. M/s. KTEK MUMBAI	Mumbai		
		3. M/s.PUNE TECHTROL (PUNE)	Pune		
		4. M/S. ELECTRONET , PUNE	PUNE		
		5. M/S. E & H (I), AURANGABAD	AURANGABAD		
		6. M/S. NEVELCO, MUMBAI	MUMBAI		
57	CAPACATIVE TYPE LEVEL INSTRUMENTS	1. M/s. SBEM PUNE	Pune		
		2. M/s. KTEK MUMBAI	Mumbai		
		3. M/s. PUNE TECHTROL (PUNE)	Pune		
58	ANALYTICAL INSTURMENTS	1. M/s. METLER TOLADO			
		2. M/s. POLYMETRON			
		3. M/s.ORBIT TECHNOLOGIES , HYDERABAD	Hyderabad		
		4. M/s.BECKMAN			
59	TURBINE METERS	1. M/s. ROCKWIN FLOW METERS , GAZIABAD	Gaziabad		
60	VORTEX FLOW METERS	1. M/s. KHRONE MARSHAL			
		2. M/s. PEPL UDAIPUR	Udaipur		
61	CONDUCTIVITY METERS/LEVEL PROBE/TRANSMITTERS	1. M/S. TECHNO INSTRUMENTS		1. M/s. LEVEL STATE USA	USA
		2. M/S. JINDAL ELECTRONICS		2. M/s. SOLOTRON MOBREY	
		3. M/S. EMERSON, BARODA	BARODA	3. M/S. JUMO, GERMANY	GERMANY
		4. M/S. ENDRESS & HAUSER, BARODA	BARODA	4. M/S. THERMO SENSOR, GMBH	GERMANY
		5. M/S. ABB, FARIDABAD	FARIDABAD		
		6. M/S. FORBES MARSHALL, PUNE	PUNE		
		7. M/S. HONEWELL, GURGAON	GURGAON		
62	UNINTERRUPTIBLE POWER SUPPLY (UPS) 240 VAC INVERTERS	1. M/S HI-REL ELECTRONICS PVT. LTD. AHMEDABAD	Ahmedabad		

		2. M/S TATA LIEBERT, MUMBAI-EMERSON			
		3. M/S KELTRON, TRIVANDRAM	Trivandram		
		4. M/S. ADOR-POWERTRON LIMITED, PUNE.	Pune.		
		5. M/S Consul Neowatt	Pune		
63	LEAD ACID BATTERIES	1. M/S. EXIDE, KOLKATA	KOLKATA		
		2. M/S. BUI, PUNE	PUNE		
64	BATTERY CHARGERS	1. M/S HBL NIFE POWER SYSTEMS LTD., HYDERABAD			
		2. M/S. CALDYNE, KOLKATA	KOLKATA		
		3. M/S. KELTRON, TRIVANDRAM	Trivandram		
		4. M/S. CHABBI ELECTRICALS PVT., LTD., JALGAON	JALGAON		
		5. M/S. MASSTECH CONTROL PVT., LTD., JALGAON	JALGAON		
65	Venturi & Flow Nozzle Assemblies	1. M/s. Temp Tech, Mumbai	Mumbai		
		2. M/s. Minco, Goa	Nashik		
		3. M/s. SGPE, Ambarnath	Ambarnathhth		
		4. M/s. Vividh Hi Feb, Vadodara	Vadodara		
		5. M/s. IL, Palghat	Palgtat		
		6. M/s. Microprecision			
		7. M/s. Hydropneumatic	Goa		
		8. M/s. General Instruments, Consortium, Chennai	Chennai		
		9. M/s. DynaFluid Valves and Flow Controls Pvt.Ltd.	Hubli		
		10. M/s. MSID	Gwalior		
66	Purge Rotameters with DP regulator	1. M/s. Transducers and Controls Ltd., Hyderabad	Hyderabad		
		2. M/s. Rockwin Flow Meter India Pvt. Ltd. Gaziabad	Gaziabad		
67	Density Gauges	1. M/s. Transducers & Control Ltd., Hyderabad	Hyderabad		
		2. M/s. Eureka Industries, Pune	Pune		
68	Metal Tube Rotameter with transmitter with	1. M/s. Transducers & Control Ltd., Hyderabad	Hyderabad		

	(4-20 mA DC)				
		2. M/s. Khrone Marshall, Pune	Pune		
69	Metal Tube Rotameters	1. M/s. Transducers & Control Ltd., Hyderabad	Hyderabad		
		2. M/s. Eureka Industries, Pune	Pune		
		3. M/s. IEPL, Hyderabad	Hyderabaddad		
70	Glass Tube Rotameters	1. M/s. Transducers & Control Ltd., Hyderabad	Hyderabad		
		2. M/s. Eureka Industries, Pune	Pune		
		3. M/s. IEPL, Hyderabad	Hyderabaddad		
71	Sight Glass Indicators	1. M/s. Crystal Instrument, Mumbai	Mumbai		
		2. M/s. Pune Techtrols, Pune	Pune		
		3. M/s. Asean instuments, Chennai	Chen chennai, chennai		
72	Paddle Type Flow Switches	1. M/s. Switzer, Chennai	Nashik		
		2. M/s.General Instruments Consortium, Mumbai	Mumbai		
73	Temperature Gauge with Thermowell (Bi metal type)	1. M/s. Goa Instruments, Goa	Goa		
		2. M/s.Baumer Technologies India Pvt Ltd			
		3. M/s.Forbes Marshall, Hyderabad	Hyderabad		
		4. M/s..H. Guru, Bangaluru	Nashik		
		5. M/s. A.N. Instruments, Kolkata	Nashik		
74	Temperature Gauge with Thermowell (Gas filled)	1. M/s. Goa Instruments, Goa	Goa		
		2. M/s. Baumer Technologies India Pvt Ltd			
		3. M/s. Forbes Marshall, Hyderabad	Hyderabad		
		4. M/s. H. Guru, Bangaluru	Nashik		
		5. M/s. A.N. Instruments, Kolkata	Nashik		
		6. M/s. WIKA	Pune		
75	Float and Tape type level indicating switches	1. M/s. SBEM Pvt. Ltd., Pune	Pune	1. M/S. KDG MOBREY, UK	UK

		2. M/s. K Tek, Mumbai	Nashik		
		3. M/s. Pune Techtrol, Pune	Pune		
		4. M/s. Nivo Controls Pvt. Ltd., Indore	Indore		
		1. M/S. LEVCON INSTRUMENTS PVT. LTD.,KOLKATA	KOLKATA		
		2. M/S. TRANSDUCERS & CONTROL PVT., LTD., HYDERABAD	HYDERABAD		
		3. M/S. CHEMTROLS ENGG., LTD, MUMBAI	MUMBAI		
76	Electric Actuators	1. M/s. Auma – India	Nashik	1. M/s. Auma – Germany	GERMANY
		2. M/s. Rotork, India	Nashik	2. M/s. Rotork, UK	UK
77	Air Filter Regulator	1. M/s. Shavo Norgen, Bangalore	Bangalore		
78	Needle Valves	1. M/S ASTEC VALVES & FITTINGS PVT. LTD.	Mumbai	1.M/s.Swagelok,USA	USA
		2. M/s. Fluid Control Pvt. Ltd, Mumbai	Mumbai	2.M/s. Parker, UK	UK
		3. M/s. Veljan Hyd Air, Mumbai	Mumbai		
		4. M/s. Leader Engineering	Nashik		
		5. M/s. Excelsior Engg.			
79	Needle Valves (Tube Ends) - Water Service			1.M/s.Swagelok,USA	USA
				2.M/s. Parker, UK	UK
80	Plug valves(with soft sleeve)	1. M/s. Xomox Sanmar,Chennai	Chennai		
81	Pressure Reducing Valves(Except oil service)	1. M/s. Dewaranee Mcncil, Calcutta	Calcutta	1. M/s. Concoa,USA	USA
		2. M/s. Indian Oxygen Ltd., Mumbai	Mumbai		
		3. M/s. Mazda Ltd, Ahmedabad	Ahmedabad		
		4. M/s. Baldota valves & Fittings, Mumbai	Mumbai		
		5. M/s. J N Marshall, Pune	Nashik		
		6. M/s. Hyd Air Engineering, Mumbai	Mumbai		
		7. M/s. Schrader-Scovill Duncan			
		8. M/s. Shavo Norgren, Mumbai	Mumbai		
		9. M/s. Veljin Hydair			
		10. M/s. Masoneilene, Mala, Kerala	Kerala		
		11. M/s. Jay Industries			

82	Pressure Reducing Valves (Oil Service)	1. M/s.Bosch Rexroth, Mumbai	Mumbai		
83	Flow Control Valves (Oil Service)	1. M/s. Bosch Rexroth, Mumbai	Mumbai	1. M/s.Parker, UK	UK
84	Special Valves e.g. Excess Flow Check valves, Differential Pressure Reducing valves, Rotary Directional Valves, etc.	1. M/s.L&T Valves Limited	Coimbatore	1. M/s. Barksdale, USA	USA
		2. M/s. MTAR, Hyderabad	Hyderadad		
		3. M/s. Nirmal Industries, Mumbai	Mumbai		
		4. M/s. Piping and Energy Products, New Delhi	New Delhi		
85	NITROGEN BLANKETING SYSTEM	1. M/s. Nirmal Industries, Mumbai	Mumbai		
86	Gas Manifold (Oxygen, Helium, CO2)	1. M/s. Indian Oxygen Ltd., Mumbai	Mumbai		
		2. M/s. Baldota valves & Fittings, Mumbai	Mumbai		
		3. M/s. Nirmal Industries, Mumbai	Mumbai		
87	Leakage Indicating Gauges (LIGs)	1. M/s. Asian Industrial valves & instruments, Chennai	Chennai		
		2. M/s. Crystal industrial Syndicate, Mumbai	Mumbai		
88	FIGs (Flow Indicating Gauges)	1. M/s. Asian Industrial Valves & Instruments, Chennai	Chennai		
		2. M/s. Sigma Industries, Mumbai	Mumbai		
		3. M/s. Suhag Process, Mumbai	Mumbai		
		4. M/s. Transducers & Controls, Hyderabad	Hyderabad		
89	Leakage Metering Device (LMDs)	1. M/s. Jayashree Industries, Hyderabad	Hyderabad		
90	Ejectors	1. M/s.Mazda Engineering, Ahmedabad	Ahmedabad		
		2. M/s. New Field Industrial Eqpt. Co. Baroda	Baroda		
91	Seal Leakage	1. M/s. Jayashree	Hyderabad		

	Measuring Device	Industries, Hyderabad			
92	Pipe section mounted Ultrasonic flow meter (WATER)	1. M/s. Khrone Marshall, Pune	Pune	1.M/s. Panametrics, U.S.A.	USA
		2. M/s. Thermo Fisher Scientific Navi Mumbai	Navi Mumbai		
93	Pipe to tube adaptors	1. M/s.Temp Tech, Mumbai	Mumbai		
		2. M/S ASTEC VALVES & FITTINGS PVT. LTD.	Vasai		
		3. M/s. Exel Hydro, Mumbai	Mumbai		
94	EPR Insulated Instrument Cables.	1. M/s.Apar Industries Limited			
		2. M/s.Reliance Engineers,			
		3. M/s.CMI Ltd. Delhi,	Nashik		
		4. M/s.Delton Cables,			
		5. M/s.Brooks, Mumbai,	Nashik		
		6. M/s.Suyog Electricals Ltd., Baroda	Baroda		
		7. M/s.Omega Cables, Chennai	Chennai		
		8. M/s. Thermo Cables Ltd.			
95	Control Cables	9. M/s. Urja Cables, Bhopal	Bhopal		
		10. M/s. Fixolite, nasik	Nashik		
		11. M/s.Apar Industries Limited	Limited		
		12. M/s. Reliance Engineers,	Nashik		
		13. M/s. CMI Ltd. Delhi,	Nashik		
		14. M/s. Delton Cables,	Nashik		
		15. M/s. Brooks, Mumbai,	Nashik		
		16. M/s. Finolex	Finolex		
		17. M/s. Asian	Asian		
		18. M/s. Fort Closter	Nashik		
		19. M/s. CCI	Cci		
		20. M/s. INCAB	Incab		
		21. M/S. PARAMOUNT COMMUNICATION, NEW DELHI	NEW DELHI		
		22. M/S. ELKAY TELELINDS LTD,. FARIDABAD			

		23. M/S. R.J. INDSUTRIAL CORPORATION, ROORKEE	ROORKEE		
		24. M/S. UNIVERSAL CABLES LTD., SATANA	SATANA		
		25. M/S SERVEL INDIA PVT LTD	DELHI		
		26. M/S. KE INDSUTRIES LTD,.NEWDELHI	NEW DELHI		
96	Cone Flow Meter	1. M/s. Hydropneumatics Pvt. Ltd., Goa.	Goa.		
97	Supply of Lab Instruments (Test & Calibration Facility)	1. M/s. WIKA Instruments Pvt. Ltd., Pune	Pune		
		2. M/s. Isothermal Technology Pvt. Ltd., Delhi.	Delhi.		
		3. M/s. Fluke Technologies Pvt. Ltd.	Mumbai		
98	Reverse Rotation Switch / probe			1.M/S SCHENCK, GERMANY	GERMANY
		2. M/s. Meggit India Private Limited		2.M/S.BENTLY NEVADA, GE USA	USA
		3. M/s. FORBES MARSHAL, PUNE	Pune	3.M/S SHINKAWA, JAPAN	JAPAN
		4. IRD Mechanalysis Limited	Mumbai		
99	Air manifold	1. M/s Coldweld Engineers pvt ltd	Bhiwandi		
100	GWR TYPE LEVEL TRANSMITTER	1. M/S. ABB INSTRUMENTS (K-TEK), FARIDABAD/ MUMBAI	MUMBAI	1. M/S. M/S. MAGNETROL, BELGUM	BELGIUM
		2. EIP Enviro, Noida (BM Tecnologie, Italy)	Noida	2. M/S. EMERSON, GERMANY	GERMANY
				3. M/S. ENDRESS & HAUSER, GERMANY	GERMANY
				4. M/S. VEGA, GERMANY	GERMANY
101	VIBRATING FORK TYPE LEVEL SWITCH	1. M/S. ENDRESS & HAUSER, AURANGABAD	AURANGABAD	1. M/S. VEGA, GERMANY	GERMANY
		2. M/S. EMERSON, BARODA	BARODA		
		3. M/S. SBEM, PUNE	PUNE		
		4. M/S. PUNE TECHTROL, PUNE	PUNE		
		5. M/S. BAUMER TECHNOLOGY (PEVIOUSLY WAREE), MUMBAI	MUMBAI		
		6. M/S. WIKA, PUNE	PUNE		

		7. M/S. SAPCON, INDORE	INDORE		
102	THERMAL MASS FLOW METER	1. M/S. FCI, NAGPUR	NAGPUR	1. M/S. MAGNETROL,	BELGIUM
				2. M/S. ENDRESS & HAUSER, GERMANY	GERMANY
				3. M/S. FCI, USA	USA
				4. M/S. SAGE, USA	USA
				5. M/S. KURZ, USA	USA
103	MASTER CLOCK SYSTEM	1. M/S. SERTEL, CHENNAI	CHENNAI		
		2. M/S. SANDS, CHENNAI	CHENNAI		
		3. M/S. MASIBUS, GANDHI NAGAR	GANDHI NAGAR		
104	H2 GAS ANALYSER CABINET	1. M/S. ABB LTD.,			
		2. M/S. YOKOGAWA BLAE STAR			
		3. M/S. HONEY WELL AUTOMATION			
		4. M/S. CHEMTROLS			
		5. M/S. SIEMENS			
		6. M/S. ADAGE AUTOMATION PVT., LTD.,			
105	TURBINE SUPERVISORY SYSTEM	1. M/S. PROVIB TECH, MUMBAI	MUMBAI	1. M/S ProvibTech,	USA
				2. M/S. BENTLY NEVADA,	USA
				3. M/S. SHINKAWA,	JAPAN
				4. M/s. MEGITT, SWITZERLAND	SWITZERLAND
106	SMPS	1. M/S. RATO, HYDERABAD	HYDERABAD		
		2. M/S. CHIRRA, BANGALORE	BANGALORE		
		3. M/S. SM CREATIVE ELECTRONICS LTD., GURGAON	GURGAON		
		4. M/S. ECIL, HYDERABAD	HYDERABAD		
107	COAXIAL CABLES			1. M/S. CABLETEL, FRANCE	FRANCE
				2. M/S. HABIA CABLES, SWEDEN	SWEDEN
				3. M/S. NEXAN, FRANCE	FRANCE
108	BRASS NICKEL PLATED WITH CHROMIUM FINISH CABLE GLANDS & PLUGS	1. M/S. COMET BRASS PRODUCTS, MUMBAI	MUMBAI		

		2. M/S. ELECTROMAC INDUSTRIES			
109	PROFIBUS ACCESSORIES	1. M/S. SIEMENS, MUMBAI	MUMBAI	1. M/S. SIEMENS, GERMANY	GERMANY
		2. M/S. PEPPERL + FUCHS , MUMBAI	MUMBAI	2. M/S. SCHNEIDER ELECTRIC, FRANCE	FRANCE
				3. M/S. TRUCH AUTOMATION, GERMANY	GERMANY
110	ETFE/PTFE, INSUL. WIRES & CABLES	1. M/S. R.J. INDSUTRIAL CORPORATION, ROORKEE	ROORKEE		
		2. M/S. FLU-TEF INDSUTRIES, AHMEDABAD	AHMEDABAD		
		3. M/S. T & F INSUALTION PVT., LTD., BULANDSHAHR	BULANDSHAHR		
		4. M/S. DELTION CABLES LTD., NEW DELHI	DELHI		
		5. M/S. MANSFIELD CABLES CO., LTD., NOIDA, UP	NOIDA, UP		
		6. M/S. SBEE CABLES (i) LTD., KANAKAPURA ROAD	ROAD		
		7. M/S. RALLISION ELECTRICALS PVT., LTD., BANGALORE	BANGALORE		
		8. M/S. TECHNO CABLES PVT., LTD., NEW DELHI	NEW DELHI		
		9. M/s.Trestar, Gaziabad	Nashik		
		10. M/s.Sanghvi Wires, Hyderabad	Hyderabad		
111	DISPLACER TYPE (TOP MOUNTED) LEVEL SWTICHES	1. M/S. LEVCON INSTRUMENTS PVT. LTD.,KOLKATA		1. M/S. KDG MOBREY, UK	UK
		2. M/S. TRANSDUCERS & CONTROL PVT., LTD., HYDERABAD	HYDERABAD		
		3. M/S. CHEMTROLS ENGG., LTD, MUMBAI	MUMBAI		
		4. M/S. PUNE TECHTROLS, PUNE			
		5. M/S. SBEM, PUNE	PUNE		

ANNEXURE X- SCOPE OF WORK & CHECKLIST OF COMMERCIAL TERMS

GEM BID NO.-

(please upload this document duly filled stamped and signed along with your offer)

SCH. NO.	SCHEDULE DESCRIPTION	QTY
1	GEAR BOX OPERATED DIA 450 BF VALVE DESIGN PRESSURE 10 KG PER SQ CM AS PER TECHNICAL SPECIFICATION PC E 08016 AND ANNEXURE I. VALVE TAG NO, LINE NO, SERVICE DESCRIPTION AS PER PC-E-08016 ANNEXURE-B	16 SET
2	SPARE FOR DIA 450 BF VALVE DESIGN PRESSURE 10 KG PER SQ CM AS PER ANNEXURE I AND TECHNICAL SPECIFICATION PC E 08016	16 SET
3	MANDATORY SPARE FOR DIA 450 BF VALVE DESIGN PRESSURE 10 KG PER SQ CM AS PER ANNEXURE I AND TECHNICAL SPECIFICATION PC E 08016	1 SET
4	GEAR BOX OPERATED DIA 500 BF VALVE AS PER TECHNICAL SPECIFICATION PC-E-08016 AND ANNEXURE-I. VALVE TAG NO, LINE NO, SERVICE DESCRIPTION AS PER PC-E-08016 ANNEXURE-B.	10 SET
5	SPARE FOR DIA 500 BF VALVE AS PER ANNEXURE I AND TECHNICAL SPECIFICATION PC E 08016	10 SET
6	MANDATORY SPARE FOR DIA 500 BF VALVE AS PER ANNEXURE I AND TECHNICAL SPECIFICATION PC E 08016	1 SET
7	GEAR BOX OPERATED DIA 600 BF VALVE AS PER TECHNICAL SPECIFICATION PC-E-08016 AND ANNEXURE-I. VALVE TAG NO, LINE NO, SERVICE DESCRIPTION AS PER PC-E-08016 ANNEXURE-B	10 SET
8	SPARE FOR DIA 600 BF VALVE AS PER ANNEXURE-I AND TECHNICAL SPECIFICATION PC-E-08016	10 SET
9	MANDATORY SPARE FOR DIA 600 BF VALVE AS PER ANNEXURE-I AND TECHNICAL SPECIFICATION PC-E-08016	1 SET
10	GEAR BOX OPERATED DIA 450 BF VALVE DESIGN PRESSURE 6 KG PER SQ CM AS PER TECHNICAL SPECIFICATION PC E 08016 AND ANNEXURE I. VALVE TAG NO, LINE NO, SERVICE DESCRIPTION AS PER PC-E-08016 ANNEXURE-B.	16 SET
11	SPARE FOR DIA 450 BF VALVE DESIGN PRESSURE 6 KG PER SQ CM AS PER ANNEXURE I AND TECHNICAL SPECIFICATION PC E 0801	16 SET
12	MANDATORY SPARE FOR DIA 450 BF VALVE DESIGN PRESSURE 6 KG PER SQ CM AS PER ANNEXURE I AND TECHNICAL SPECIFICATION PC E 08016	1 SET
13	GEAR BOX OPERATED DIA 700 BF VALVE AS PER TECHNICAL SPECIFICATION PC-E-08016 AND ANNEXURE-I. VALVE TAG NO, LINE NO, SERVICE DESCRIPTION AS PER PC-E-08016 ANNEXURE-B	4 SET
14	SPARE FOR DIA 700 BF VALVE AS PER ANNEXURE-I AND TECHNICAL SPECIFICATION PC-E-08016	4 SET
15	MANDATORY SPARE FOR DIA 700 BF VALVE AS PER ANNEXURE-I AND TECHNICAL SPECIFICATION PC-E-08016	1 SET
16	GEAR BOX OPERATED DIA 1200 BF VALVE AS PER TECHNICAL SPECIFICATION PC-E-08016 AND ANNEXURE-I. VALVE TAG NO, LINE NO, SERVICE DESCRIPTION AS PER PC-E-08016 ANNEXURE-B	2 SET
17	SPARE FOR DIA 1200 BF VALVE AS PER ANNEXURE-I AND TECHNICAL SPECIFICATION PC-E-08016	2 SET
18	MANDATORY SPARE FOR DIA 1200 BF VALVE AS PER ANNEXURE-I AND TECHNICAL SPECIFICATION PC-E-08016	1 SET
19	ELECTRICALLY OPERATED DIA 1800 BF VALVE AS PER TECHNICAL SPECIFICATION PC-E-08017 AND ANNEXURE-I. VALVE TAG NO, LINE NO, SERVICE DESCRIPTION AS PER PC-E-08017 ANNEXURE-B.	24 SET
20	SPARE FOR DIA 1800 BF VALVE AS PER ANNEXURE-I AND TECHNICAL SPECIFICATION PC-E-08017	24 SET
21	MANDATORY SPARE FOR DIA 1800 BF VALVE AS PER ANNEXURE-I AND TECHNICAL SPECIFICATION PC-E-08017	1 SET
22	ELECTRICALLY OPERATED DIA 500 BF VALVE AS PER TECHNICAL SPECIFICATION PC-E-08017 AND ANNEXURE-I. VALVE TAG NO, LINE NO, SERVICE DESCRIPTION AS PER PC-E-08017 ANNEXURE-B	2 SET
23	SPARE FOR DIA 500 BF VALVE AS PER ANNEXURE-I AND TECHNICAL SPECIFICATION PC-E-08017	2 SET
24	MANDATORY SPARE FOR DIA 500 BF VALVE AS PER ANNEXURE-I AND TECHNICAL SPECIFICATION PC-E-08017	1 SET
ENQUIRY TECHNICAL TERM : AS PER ENCLOSED SPECIFICATION PC-E-08016, PC-E-08017 AND ANNEXURE-I		
SUPPLIER TECHNICAL TERM: AS PER ENCLOSED SPECIFICATION PC-E-08016, PC-E-08017 AND ANNEXURE-I.		

ANNEXURE X- SCOPE OF WORK & CHECKLIST OF COMMERCIAL TERMS
GEM BID NO.-
(please upload this document duly filled stamped and signed along with your offer)

INSPECTION TERMS: BHEL TPIA & CLIENT AT VENDOR WORKS BEFORE DISPATCH AS PER APPROVED QAP		
SL No	**TERMS AND CONDITIONS**	**REMARKS**
1	PRICE SUBMITTED MUST BE **INCLUSIVE** OF GST, FREIGHT, INSURANCE AND ALL CHARGES UPTO DELIVERY DESTINATION (IN LINE WITH GEM GTC).	
2	SUBMIT **PO COPIES AND DISPATCH DETAILS (INVOICE & LR)**, AS CALLED FOR, IN SUPPORT OF EXPERIENCE, AS APPLICABLE. **SAME/SIMILAR PRDUCT IS DEFINED IN ENCLOSED PQR**. SUBMIT BALANCE SHEET & PROFIT LOSS STATEMENT OR CA CERTIFICATE FOR TURNOVER CRITERIA. **SUBMIT STAMPED AND SIGNED ENCLOSED PQR ALSO.**	
3	PLEASE CONFIRM AGREEMENT TO SCOPE OF WORK AND TECHNICAL CONDITION AS PER BID AND SUBMIT STAMPED AND SIGNED COPY OF SAME	
4	MENTION TECHNICAL DEVIATION, IF ANY IN ENCLOSED SHEER	
5	REQUIRED DELIVERY IS **26 WEEKS** FROM APPROVAL OF LAST DOCUMENT. PLEASE COMMENT.	
6	VENDORS HAVE TO SUBMIT DOCUMENTS FOR APPROVAL WITHIN 10 DAYS OF PO AND RESUBMISSION WITHIN 5 DAYS FROM BHEL COMMENT. CONTRACTUAL DELIVERY FOR LD PURPOSE SHALL BE RE-FIXED FROM DATE OF LAST DOCUMENT APPROVAL AFTER DEDUCTING DELAY ON VENDOR'S PART, IF ANY, IN SUBMISSION/ RE-SUBMISSION OF DOCUMENTS.	
7	**INDIAN MANUFACTURERS** ARE ONLY ALLOWED TO PARTICIPATE. BIDDER TO SUBMIT DOCUMENTS IN SUPPORT OF THEIR CLAIM OF BEING ABOVE.	
8	PAYMENT TERMS SHALL BE AS- 100% PAYMENT WITHIN 90 DAYS OF RECEIPT (45 DAYS FOR MSE & 60 DAYS FOR MEDIUM ENTERPRISE) SUBJECT TO ACCEPTANCE OF MATERIAL AT BHEL. SITE RECEIVED COPY OF LR ALONG WITH INVOICES TO BE SENT TO BUYER FOR PAYMENT. AS PER ORDER F. No. 1(2)(1)/ 2016-MA DATED 09/02/2017 FROM MIN. OF MSME TRADERS/AGENTS ARE NOT ALLOWED FOR BENEFITS/RELAXATIONS EXTENDED TO MSEs	
9	PLEASE CONFIRM ACCEPTANCE TO **GEM GTC/BID ATC AND LD CLAUSE**	
10	SUPPLIER TO FURNISH MATERIAL TC & GC TO PO ISSUING AUTHORITY AFTER SUPPLY	
11	CONFIRM **UDYAM CERTIFICATE** IS SUBMITTED, IN CASE BIDDER IS AN MSME VENDOR.	
12	MENTION **HSN CODE** OF THE ITEM AND GST PERCENTAGE APPLICABLE	
13	CONFIRM DULY STAMPED & SIGNED ANNEXURE Y IN COMPLIANCE TO CONFLICT OF INTEREST IS SUBMITTED.	
14	CONFIRM DULY STAMPED & SIGNED ANNEXURE Z IN COMPLIANCE TO MAKE IN INDIA IS SUBMITTED.	
15	VENDOR APPROVAL FORM IN ENCLOSED FORMAT ALONG WITH SUPPORTING DOCUMENTS ARE TO BE SUBMITTED FOR NPCIL APPROVAL. PRICE BID OF VENDORS, WHO ARE APPROVED BY NPCIL, SHALL ONLY BE OPENED.	
16	AS VENDOR APPROVAL IS INVOLVED, PLEASE PROVIDE OFFER VALIDITY OF **120 DAYS** FROM DATE OF PART 1 BID OPENEING.	
17	PLEASE CONFIRM DULY FILLED INTEGRITY PACT HAVING STAMPED AND SIGNED ON EACH PAGE IS SUBMITTED	
18	PERFORMANCE SECURITY IS TO BE FURNISHED BY VENDOR WITHIN 30(THIRTY) DAYS AFTER NOTIFICATION OF THE AWARD) AND IT SHOULD REMAIN VALID FOR A PERIOD OF 60 (SIXTY) DAYS BEYOND THE DATE OF COMPLETION OF ALL CONTRACTUAL OBLIGATIONS OF THE SUPPLIER, INCLUDING WARRANTY OBLIGATIONS. PLEASE CONFIRM	

ANNEXURE- Y

DECLARATION BY BIDDERS REGARDING CONFLICT OF INTEREST

"A bidder shall not have conflict of interest with other bidders. Such conflict of interest can lead to anti-competitive practices to the detriment of Procuring Entity's interests. **The bidder found to have a conflict of interest shall be disqualified**. A bidder may be considered to have a conflict of interest with one or more parties in this bidding process, if:

a) they have controlling partner (s) in common;· or

b) they receive or have received any direct or indirect subsidy/ financial stake from any of them; or

c) they have the same legal representative/agent for purposes of this bid; or

d) they have relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the bid of another Bidder,· or

e) Bidder participates in more than one bid in this bidding process. Participation by a Bidder in more than one Bid will result in the disqualification of all bids in which the parties are involved. However, this does not limit the inclusion of the components/ sub-assembly/ Assemblies from one bidding manufacturer in more than one bid; or

f) In cases of agents quoting in offshore procurements, on behalf of their principal manufacturers, one agent cannot represent two manufacturers or quote on their behalf in a particular tender enquiry. One manufacturer can also authorise only one agent/dealer.

There can be only one bid from the following:

1. The principal manufacturer directly or through one Indian agent on his behalf; and

2. Indian/foreign agent on behalf of only one principal, or

g) A Bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the contract that is the subject of the Bid, or

h) In case of a holding company having more than one independently manufacturing units, or more than one unit having common business ownership/management, only one unit should quote. Similar restrictions would apply to closely related sister companies. Bidders must proactively declare such sister/ common business/ management units in same/ similar line of business. "

We confirm to above conditions of NIT against **enquiry no/ GeM bid no- …….**

Sign/seal of bidder

(……)

For M/s. ……

BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL

MATERIAL MANAGEMENT – THERMAL DIVISION

ANNEXURE-Z

For this Procurement, Government of India Public Procurement (Preference to Make in India), Order 2017 revised on 04/06/2020 with its amendments and subsequent Orders issued by the respective nodal ministries shall be applicable even if issued after issue of this NIT but before finalization of contract/PO/WO against this NIT.

As per the Provisions of this order, please submit ***a self-certification complying with the conditions below on company letterhead duly signed by competent authority****.*

Format:

I ……., hereby declare on behalf of M/s. …… that we are participating in the Enquiry No. …… floated by BHEL, Bhopal (MP), India and shall comply with following:

1. Public Procurement (Preference to Make in India), Order 2017 revised on 04/06/2020 *with its amendments* and subsequent Orders issued by the respective nodal ministries shall be applicable even if issued after issue of this NIT but before finalization of contract/PO/WO against this NIT.

2. As per the Provisions of this order, **only "Class-I/~~Class-II Local Suppliers~~/~~Non Local Suppliers~~"** are eligible to bid for the tender.

(a) A supplier will be treated as **"Class-I Local Suppliers",** if the items quoted by bidder have local content equal to or more than 50%.
(b) A supplier will be treated as **"Class-II Local Suppliers",** if the items quoted by bidder have local content more than 20% but less than 50%.
(c) A supplier will be treated as **"Non Local Suppliers",** if the items quoted by bidder have local content less than or equal to 20%.
(d) '**Local Content'** means the amount of value added in India, which shall be total value of item quoted (excluding net domestic indirect taxes) minus the value of imported content in the item (including all custom duties) as a proportion of the total value, **in percent**.

3. I hereby declare that our firm qualifies as **"Class-I/Class-II Local Suppliers"** (Tick as applicable).
a. The Local Content in the items quoted under this Enquiry is ……. Percent
b. Details of location(s) in India where this value addition shall be done, is/are as follows: **(Mention Factory location)**

(a) ……..
(b) ……..

4. It is certified that we are **Manufacturer** of items under the bid.

5. That in the event of the local content of the goods/services/works mentioned herein is found to be incorrect and not meeting the prescribed Minimum Local Content criteria, based on the assessment of procuring agency (ies)/BHEL/Government Authorities for the purpose of assessing the local content, action shall be taken against me/my firm in line with the PPP-MII order and provisions of the Integrity pact/ Bidding Documents.

(……)

For M/s. ……

(Seal & Sign)