Annexure-1

INTEGRITY PACT

Between

Bharat Heavy Electricals Ltd. (BHEL), a company registered under the Companies Act 1956 and having its registered office at "BHEL House", Siri Fort, New Delhi - 110049 (India) hereinafter referred to as "The Principal", which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the ONE PART

and

_____, (description of the party along with address), hereinafter referred to as "The Bidder/ Contractor" which expression unless repugnant to the context or meaning hereof shall include its successors or assigns of the OTHER PART

Preamble

The Principal intends to award, under laid-down organizational procedures, contract/s for _____

_____ (hereinafter referred to as "Contract"). The Principal values full compliance with all relevant laws of the land, rules and regulations, and the principles of economic use of resources, and of fairness and transparency in its relations with its Bidder(s)/ Contractor(s).

In order to achieve these goals, the Principal will appoint panel of Independent External Monitor(s) (IEMs), who will monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1- Commitments of the Principal

1.1 The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles: -

1.1.1 No employee of the Principal, personally or through family members, will in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

1.1.2 The Principal will, during the tender process treat all Bidder(s) with equity and reason. The Principal will in particular, before and during the tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.

1.1.3 The Principal will exclude from the process all known prejudiced persons.

1.2 If the Principal obtains information on the conduct of any of its employees which is a penal offence under the Indian Penal Code 1860 and Prevention of Corruption Act 1988 or any other statutory penal enactment, or if there be a substantive suspicion in this regard, the Principal will inform its Vigilance Office and in addition can initiate disciplinary actions.

Section 2 - Commitments of the Bidder(s)/ Contractor(s)

2.1 The Bidder(s)/ Contractor(s) commit himself to take all measures necessary to prevent corruption. The Bidder(s)/ Contractor(s) commits himself to observe the following principles during participation in the tender process and during the contract execution.

S. Anand

2.1.1 The Bidder(s)/ Contractor(s) will not, directly or through any other person or firm, offer, promise or give to the Principal or to any of the Principal's employees involved in the tender process or the execution of the contract or to any third person any material, immaterial or any other benefit which he/ she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

2.1.2 The Bidder(s)/ Contractor(s) will not enter with other Bidder(s) into any illegal or undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process.

2.1.3 The Bidder(s)/ Contractor(s) will not commit any penal offence under the relevant Indian Penal Code (IPC) and Prevention of Corruption Act; further the Bidder(s)/ Contractor(s) will not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Principal as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

2.1.4 Foreign Bidder(s)/ Contractor(s) shall disclose the name and address of agents and representatives in India and Indian Bidder(s)/ Contractor(s) to disclose their foreign principals or associates. The Bidder(s)/ Contractor(s) will, when presenting his bid, disclose any and all payments he has made, and is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the contract.

2.2 The Bidder(s)/ Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

2.3 The Bidder(s)/ Contractor(s) shall not approach the Courts while representing the matters to IEMs and shall await their decision in the matter.

Section 3 - Disqualification from tender process and exclusion from future contracts

If the Bidder(s)/ Contractor(s), before award or during execution has committed a transgression through a violation of Section 2 above, or acts in any other manner such as to put his reliability or credibility in question, the Principal is entitled to disqualify the Bidder(s)/ Contractor(s) from the tender process , terminate the contract, if already awarded, exclude from future business dealings and/ or take action as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 4 - Compensation for Damages

4.1 If the Principal has disqualified the Bidder (s) from the tender process before award / order acceptance according to Section 3, the Principal is entitled to demand and recover the damages equivalent to Earnest Money Deposit/ Bid Security.

4.2 If the Principal is entitled to terminate the Contract according to Section 3, or terminates the Contract in application of Section 3 above , the Bidder(s)/ Cotractor (s) transgression through a violation of Section 2 above shall be construed breach of contract and the Principal shall be-entitled to demand and recover from the Contractor an amount equal to 5% of the contract value or the amount equivalent to Security Deposit/ Performance Bank Guarantee , whichever is higher, as damages, in addition to and without prejudice to its right to demand and recover compensation for any other loss or damages specified elsewhere in the contract.

S. Anand

Section 5 - Previous Transgression

5.1 The Bidder declares that no previous transgressions occurred in the last 3 (three) years with any other company in any country conforming to the anti-corruption approach or with any other Public Sector Enterprise in India that could justify his exclusion from the tender process.

5.2 If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason or action can be taken as per the separate "Guidelines on Banning of Business dealings with Suppliers/ Contractors", framed by the Principal.

Section 6 - Equal treatment of all Bidder (s)/ Contractor (s) / Sub-contractor (s)

6.1 The Principal will enter into Integrity Pacts with identical conditions as this Integrity Pact with all Bidders and Contractors.

6.2 In case of Sub-contracting, the Principal Contractor shall take the responsibility of the adoption of Integrity Pact by the Sub-contractor(s) and ensure that all Sub-contractors also sign the Integrity Pact.

6.3 The Principal will disqualify from the tender process all Bidders who do not sign this Integrity Pact or violate its provisions.

Section 7 - Criminal Charges against violating Bidders/ Contractors /Subcontractors

If the Principal obtains knowledge of conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Principal has substantive suspicion in this regard, the Principal will inform the Vigilance Office.

Section 8 -Independent External Monitor(s)

8.1 The Principal appoints competent and credible panel of Independent External Monitor (s) (IEMs) for this Integrity Pact. The task of the IEMs is to review independently and objectively, whether and to what extent the parties comply with the obligations under this Integrity Pact.

8.2 The IEMs are not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. He reports to the CMD, BHEL.

8.3 The IEMs shall be provided access to all documents/ records pertaining to the Contract, for which a complaint or issue is raised before them as and when warranted. However, the documents/records/information having National Security implications and those documents which have been classified as Secret/Top Secret are not to be disclosed.

8.4 The Principal will provide to the IEMs sufficient information about all meetings among the parties related to the Contract provided such meetings could have an impact on the contractual relations between the Principal and the Contractor. The parties offer to the IEMs the option to participate in such meetings.

8.5 The advisory role of IEMs is envisaged as that of a friend, philosopher and guide. The advice of IEMs would not be legally binding and it is restricted to resolving issues raised by a Bidder regarding any aspect of the tender which allegedly restricts competition or bias towards some Bidders. At the same time, it must be understood that IEMs are not consultants to the Management. Their role is independent in nature and the advice once tendered would not be subject to review at the request of the organization.

8.6 For ensuring the desired transparency and objectivity in dealing with the complaints arising out of any tendering process or during execution of Contract, the matter should be examined by the full panel of IEMs jointly, who would look into the records, conduct an investigation, and submit their joint recommendations to the Management.

8.7 The IEMs would examine all complaints received by them and give their recommendations/ views to the CMD, BHEL at the earliest. They may also send their report directly to the CVO, in case of suspicion of serious irregularities requiring legal/ administrative action. Only in case of very serious issue having a specific, verifiable Vigilance angle, the matter should be reported directly to the Commission. IEMs will tender their advice on the complaints within 30 days.

8.8 The CMD, BHEL shall decide the compensation to be paid to the IEMs and its terms and conditions.

8.9 IEMs should examine the process integrity, they are not expected to concern themselves with fixing of responsibility of officers. Complaints alleging mala fide on the part of any officer of the Prinicpal should be looked into by the CVO of the Principal.

8.10 If the IEMs have reported to the CMD, BHEL, a substantiated suspicion of an offence under relevant Indian Penal Code / Prevention of Corruption Act, and the CMD, BHEL has not, within reasonable time, taken visible action to proceed against such offence or reported it to the Vigilance Office, the IEMs may also transmit this information directly to the Central Vigilance Commissioner, Government of India.

8.11 After award of work, the IEMs shall look into any issue relating to execution of Contract, if specifically raised before them. As an illustrative example, if a Contractor who has been awarded the Contract, during the execution of Contract, raises issue of delayed payment etc. before the IEMs, the same shall be examined by the panel of IEMs. Issues like warranty/ guarantee etc. shall be outside the purview of IEMs.

8.12 However, the IEMs may suggest systemic improvements to the management of the Principal, if considered necessary, to bring about transparency, equity and fairness in the system of procurement.

8.13 The word `Monitor' would include both singular and plural.

Section 9 - Pact Duration

9.1 This Integrity Pact shall be operative from the date this Integrity Pact is signed by both the parties till the final completion of contract for successful Bidder, and for all other Bidders 6 months after the Contract has been awarded. Any violation of the same would entail disqualification of the bidders and exclusion from future business dealings.

9.2 If any claim is made/ lodged during currency of this Integrity Pact, the same shall be binding and continue to be valid despite the lapse of this Pact as specified above, unless it is discharged/ determined by the CMD, BHEL.

S. Anand

Section 10 - Other Provisions

10.1 This Integrity Pact is subject to Indian Laws and exclusive jurisdiction shall be of the competent Courts as indicated in the Tender or Contract, as the case may be.

10.2 Changes and supplements as well as termination notices need to be made in writing.

10.3 If the Bidder(s)/ Contractor(s) is a partnership or a consortium or a joint venture, this Integrity Pact shall be signed by all partners of the partnership or joint venture or all consortium members.

10.4 Should one or several provisions of this Integrity Pact turn out to be invalid, the remainder of this Integrity Pact remains valid. In this case, the parties will strive to come to an agreement to their original intentions.

10.5 Only those bidders / contractors who have entered into this Integrity Pact with the Principal would be competent to participate in the bidding. In other words, entering into this Integrity Pact would be a preliminary qualification.

10.6 In the event of any dispute between the Principal and Bidder(s)/ Contractor(s) relating to the Contract, in case, both the parties are agreeable, they may try to settle dispute through Mediation before the panel of IEMs in a time bound manner. In case, the dispute remains unresolved even after mediation by the panel of IEMs, either party may take further action as the terms & conditions of the Contract. The fees/expenses on dispute resolution through mediation shall be shared by both the parties. Further, the mediation proceedings shall be confidential in nature and the parties shall keep confidential all matters relating to the mediation proceedings including any settlement agreement arrived at between the parties as outcome of mediation. Any views expressed, suggestions, admissions or proposals etc. made by either party in the course of mediation shall not be relied upon or introduced as evidence in any further arbitral or judicial proceedings, whether or not such proceedings relate to the dispute that is the subject of mediation proceedings. Neither of the parties shall present IEMs as witness in any Alternative Dispute Resolution or judicial proceedings in respect of the dispute that was subject of mediation.

S. Anand Kumar एस. आनंद कुमार / S. ANAND KUMAR
वरिष्ठ उप महाप्रबंधक
Sr. Deputy General Manager
सामग्री प्रबंधन / आरएम
Materials Management / RM
तिरुच्चि / BHEL, Trichy - 620 014

For & On behalf of the Principal
(Office Seal)

For & On behalf of the Bidder/ Contractor
(Office Seal)

Place TRICHY
Date 19.04.2022

Witness: Krishna Samad
(Name & Address) KRISHNA SAMAD
BHEL, TRICHY

Witness:_____
(Name & Address) _____
_____

BHARAT HEAVY ELECTRICALS LIMITED
MM/RM/PURCHASE/PIPES

Ref: MM: Pur:Pipe:PC: Rev 00 **Dt:15.03.2021**

Pre-Qualification requirements (POR) for the procurement of Seamless Carbon Steel/Alloy Steel Pipes through Open Tender (As per TDG:7381: Rev01 & TDG:101 Rev 13)

A) **Organizational Capability:**

1. Manufacturers having Pipe mill are only eligible to participate. Offers from traders, re-rollers (Suppliers having only cold finishing facility), fabricators and stockists are not acceptable and will not be considered for evaluation.

2. Source of raw material (Billets or blooms) for the manufacturing of Pipes shall be from **IBR** approved well known steel maker or certified by **IBR** approved inspecting authority (Form-IV to be attached in all cases). If the Raw material is sourced from different sources, all the sources should be indicated in the offer, and the supplies should be restricted to the indicated list of raw material sources.

3. Vendor to indicate the nature of the firm. Product catalogue shall be submitted.

4. Suppliers shall submit filled in supplier facility report for Pipe mill (Format enclosed). Suppliers without basic manufacturing facilities in-house, shall not be considered for evaluation. In house facilities for Heat treatment & Non-Destructive Testing (On-line UT & Online Thickness Measurement facility for Pipes) are mandatory requirements for consideration of the offer.

5. Chemical, Mechanical testing shall be done in house or at Labs certified as per ISO 17025 or Government approved labs.

6. Suppliers shall submit a valid ISO 9001 certificate or Quality Assurance Manual or Written down procedure.

7. BHEL/End customer reserve the right to inspect the item ordered at any stage at vendor's works and if found not meeting the stipulated conditions, material is liable for rejection.

8. BHEL/End customer reserves the right to inspect the first lot of materials at vendor's works for giving clearance before bulk production.

9. BHEL reserves the right to visit supplier's works to audit and inspect to ensure the capability for technical evaluation.

10. BHEL reserves the right to carry out audit checks at BHEL on the materials supplied at the time of receipt.

B) **Technical Competence:**

1. Point by point confirmation to the TDG requirements is mandatory for consideration of offer and signed TDG shall be submitted.

2. Suppliers shall submit manufacturing process flow chart from Raw material (Billets or Blooms) to finished product to meet the TDG requirements along with technical bid.

3. Suppliers shall submit the experienced manpower details specific to Manufacturing, Quality and NDE requirements.

16/3/2021
K. UDAYA KUMAR
Deputy Manager
MM / RM / Planning (Pipes)
Materials Management / FB
BHEL, TRICHY - 620 014.

16/3/2021
नंदिनी. जे / NANTHINI .J
उप प्रबंधक, गुणवत्ता / Deputy Manager, Quality
बीएचईएल, पाईपिंग सेन्टर / BHEL, Piping Centre
टी. नगर, चेन्नै - 17 / T. Nagar, Chennai

Ref: MM: Pur:Pipe:PC: Rev 00 **Dt:15.03.2021**

Pre-Qualification requirements (POR) for the procurement of Seamless Carbon Steel/Alloy Steel Pipes through Open Tender (As per TDG:7381: Rev01 & TDG:101 Rev 13)

C) Past Experience/ Performance:

1. Suppliers shall indicate their annual installed capacity for the tendered specifications & it shall be more than the tendered quantity for each specification.

2. **Suppliers shall have supplied Pipes as per the specification given below.**
   i. For Carbon Steel Pipes: Either in SA106GRB/ SA106GRC or any alloy steel Grades.
   ii. For Alloy Steel Pipes: Either in SA335P12 / SA335P22 or any higher alloy steel grades.
   iii. For Alloy Steel Pipes (SA335P91): Either in SA335P91/ SA335P92 Grades
   iv. For Alloy Steel Pipes (SA335P92): In respective grade SA335P92.

3. Details of supplies made in past 5 years indicating the Quantity, Size, Specification & Customer details shall be submitted year wise.

4. Unpriced PO copies & Proof of supply (such as invoice / bill of lading copies and sample test certificates) against the tendered specification shall be submitted as mentioned above in Clause C2.

5. Unpriced PO copies & Proof of supply (such as invoice / bill of lading copies and sample test certificates) covering minimum and maximum sizes meeting the tendered size requirements shall be submitted as mentioned above in Clause C2.

6. The manufacturing size range shall be indicated in the offer. However, if credential is not available for any specific tendered size, then specific declaration shall be submitted by mill stating the capability to produce that quoted size/s.

D) Financial Soundness:

1. Indigenous suppliers shall submit Audited copies of annual reports (Balance Sheets), Profit & Loss statement for the last four years (or from date of incorporation whichever is less).

2. Import suppliers shall submit latest report from a reputed third party business rating agency like Dun & Bradstreet, Credit reform etc.

Necessary supporting documents shall be submitted for meeting each of the above Pre-Qualification Criteria for evaluation of the offers.

BHEL shall consider/Not-consider the offers based on the evaluation of documents submitted for the above Pre-Qualification Criteria. If required, BHEL shall make on-site assessment of the facilities at supplier's works during the bid evaluation.

16/3/2021
K. UDAYA KUMAR
Deputy Manager
MM / RM / Planning (Pipes)
Materials Management / FB
BHEL, TRICHY - 620 014.

16/03/2021
नंदिनी. जे / NANTHINI .J
उप प्रबंधक, गुणवत्ता / Deputy Manager, Quality
बीएचईएल, पाइपिंग सेन्टर / BHEL, Piping Centre
टी. नगर, चेन्नै - 17 / T. Nagar, Chennai - 17

BHARAT HEAVY ELECTRICALS LIMITED
MM/RM/PURCHASE/PIPES

Dt:07.03.2022

MM:RM: PUR: YAD: TIP - REV 00

Pre-Qualification requirements (POR) for the procurement of Seamless Carbon Steel/Alloy Steel Pipes through Open Tender (As per TDG: 40 Rev 01)

A) Organizational Capability:

1. Manufacturers having Pipe mill are only eligible to participate. Offers from traders, re-rollers (Suppliers having only cold finishing facility), fabricators and stockists are not acceptable and will not be considered for evaluation.

2. Source of raw material (Billets or blooms) for the manufacturing of Pipes shall be indicated in the offer and the supplies should be restricted to the list of raw material sources indicated in the offer.

3. Vendor to indicate the nature of the firm. Product catalogue shall be submitted.

4. Suppliers shall submit filled in supplier facility report for Pipe mill (Format enclosed). Suppliers without basic manufacturing facilities in-house, shall not be considered for evaluation. In house facilities for Heat treatment & Non-Destructive Testing are mandatory requirements for consideration of the offer.

5. Chemical, Mechanical testing shall be done in house or at Labs certified as per ISO 17025 or Government approved labs.

6. Suppliers shall submit a valid ISO 9001 certificate or Quality Assurance Manual or Written down procedure.

7. BHEL/End customer reserve the right to inspect the item ordered at any stage at vendor's works and if found not meeting the stipulated conditions, material is liable for rejection.

8. BHEL/End customer reserves the right to inspect the first lot of materials at vendor's works for giving clearance before bulk production.

9. BHEL reserves the right to visit supplier's works to audit and inspect to ensure the capability for technical evaluation.

10. BHEL reserves the right to carry out audit checks at BHEL on the materials supplied at the time of receipt.

B) Technical Competence:

1. Point by point confirmation to the TDC requirements is mandatory for consideration of offer and signed TDC shall be submitted.

2. Suppliers shall submit manufacturing process flow chart from Raw material (Billets or Blooms) to finished product to meet the TDC requirements along with technical bid.

3. Suppliers shall submit the experienced manpower details specific to Manufacturing, Quality and NDE requirements.

S. DHANABAL
By. Manager / MPLG
MM / RM / Purchase / Tubes
BHEL, TRICHY - 620 014

सांड्रा प्रिया. डी / SANDHA PRIYA .D
प्रबंधक, गुणवत्ता एवं व्यावसायिक उत्कृष्टता
Manager, Quality & Business Excellence
बीएचईएल, पाईपिंग सेन्टर / BHEL, Piping Centre
टी. नगर, चेन्नै / T. Nagar, Chennai

Dt:07.03.2022

MM:RM: PUR: YAD: TIP - REV 00

Pre-Qualification requirements (POR) for the procurement of Seamless Carbon Steel/Alloy Steel Pipes through Open Tender (As per TDG: 40 Rev 01)

C) Past Experience/ Performance:

1. Suppliers shall indicate their annual installed capacity for the tendered specifications & it shall be more than the tendered quantity for each specification.

2. Suppliers shall have supplied Pipes as per the specification given below.
   - For Carbon Steel Pipes: Either in SA106GRB/ SA106GRC or any alloy steel Grades.
   - For Alloy Steel Pipes: Either in SA335P12 / SA335P22 or any higher alloy steel grades.
   - For Alloy Steel Pipes (SA335P91): Either in SA335P91/ SA335P92 Grades

3. Details of supplies made in past 5 years indicating the Quantity, Size, Specification & Customer details shall be submitted year wise.

4. Unpriced PO copies & Proof of supply (such as invoice / bill of lading copies and sample test certificates) against the tendered specification shall be submitted as mentioned above in Clause C2.

5. Unpriced PO copies & Proof of supply (such as invoice / bill of lading copies and sample test certificates) covering minimum and maximum sizes meeting the tendered size requirements shall be submitted as mentioned above in Clause C2.

6. The manufacturing size range shall be indicated in the offer. However, if credential is not available for any specific tendered size, then specific declaration shall be submitted by mill stating the capability to produce that quoted size/s.

D) Financial Soundness:

1. Indigenous suppliers shall submit Audited copies of annual reports (Balance Sheets), Profit & Loss statement for the last four years (or from date of incorporation whichever is less).

2. Import suppliers shall submit latest report from a reputed third party business rating agency like Dun & Bradstreet, Credit reform etc.

Necessary supporting documents shall be submitted for meeting each of the above Pre-Qualification Criteria for evaluation of the offers.

BHEL shall consider/Not-consider the offers based on the evaluation of documents submitted for the above Pre-Qualification Criteria. If required, BHEL shall make on-site assessment of the facilities at supplier's works during the bid evaluation.

S. DHANAPAL
By. Manager/MPLG
MM / RM / Purchase
BHEL, TRICHY

Manager, Quality & Business Excellence
प्रबंधक, गुणवत्ता एवं व्यावसायिक उत्कृष्टता
BHEL, Piping Centre / बीएचईएल, पाईपिंग सेन्टर
T. Nagar, Chennai / टी. नगर, चेन्नै

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPALLI 620 014

QUALITY ASSURANCE

COLOUR CODES FOR TUBES AND PIPES
(FOR BOILERS, PRESSURE VESSELS & HEAT EXCHANGERS)

REVISION	DATE	PREPARED	REVIEWED	APPROVED
01	05-02-1999	R. Sasikumar	A. R. Reddy	K. Rengachari
02	22-07-2004	K. Ganesan	U. Revisankaran	C. R. Raju
03	20-01-2009	V. Kalyanaraman	S.Selvarajan	U. Revisankaran
04	13-05-2011	C. Haritha	V. Kalyanaraman	S. Selvarajan
05	27-05-2015	Vaibhav Saxena	S. Selvarajan	U. Revisankaran
06	28-10-2015	Vaibhav Saxena	Manu Shankar. H	S. Selvarajan
07	21-12-2016	Vaibhav Saxena 21-12-2016	S. Selvarajan 21/12/16	U. Revisankaran 21/12/16

RECORD OF REVISIONS

Rev. No	Clause No.	Details of Revision	Remarks
01		New Specifications included based on TDC revision.	--
02		Amendment A1 dt. 26.04.01 issued for Rev. 01 incorporated. Colour code for SA 213 Gr. T23 added.	--
03		1) Colour code for SA 213 Gr. T92, P23, P92, SA178 Gr. D added. 2) Colour code for SA 210 Gr. C modified to BLUE only.(From BLUE & GREEN)	--
04		Colour code for super 304H added	--
05		1) First para modified for clarity for colour codes containing more than one colours. 2) UNS number for Super 304H added.	--
06		Colour code for super 304H corrected in line with Revision 04.	--
07		1) First paragraph modified to include Instructions for sequence for colour code bands. 2) Sl. No. column added in table. 3) Colour code for SA 312 Gr. TP 304H added.	--

Following Colour codes are to be applied as longitudinal bands (if not specified in other documents) on tubes & pipes to identify them to specification during receipt, storage, issue and processing. For heat exchanger tubes circumferential colour code can be provided at both ends of tubes (300 mm away from end). If the Colour code contains more than one Colour then bands of Colours shall be applied adjacent to each other without any overlap. ***In case of multiple colour bands, the sequence shall be maintained as indicated in the table.***

Sl. No.	Specification	Colour 1	Colour 2	Colour 3
1.	12 X 1 MØ	RED	YELLOW	
2.	13 Cr Mo 44	ALUMINIUM	BLACK	
3.	A 200 Gr. T5	ALUMINIUM	RED	YELLOW
4.	A 200 Gr. T9	ALUMINIUM	GREEN	YELLOW
5.	AISI 602	WHITE	YELLOW	
6.	API 5L Gr. B	ALUMINIUM		
7.	BS 3059 PART2 CDS/HFS 360	ALUMINIUM	BLACK	BROWN
8.	BS 3059 P2 S2 440	ALUMINIUM	BLACK	RED
9.	BS 3059 P2 S2 622 Gr. 490	ALUMINIUM	BLACK	GREEN
10.	BS 3602 PART1 CDS 360	ALUMINIUM	BLACK	BLUE
11.	NFA49-213 42C	ALUMINIUM	BLUE	BROWN
12.	NFA49-213 TU 10CD9.10	ALUMINIUM	BLUE	RED
13.	NFA49-213 TU 15CD2.05	ALUMINIUM	BLUE	GREEN
14.	NFA49-213 TU Z10CD9	ALUMINIUM	BLUE	YELLOW
15.	NFA49-213 TU Z10CDVNB09.01	ALUMINIUM	GREEN	RED
16.	SA 106 Gr. B	RED		
17.	SA 106 Gr. C	BLUE		
18.	SA 178 Gr. D	ORANGE		
19.	SA 179	BLACK	BLUE	GREEN
20.	SA 192	WHITE		
21.	SA 199 T5	BLUE	BROWN	RED
22.	SA 209 Gr. T1	ALUMINIUM	RED	
23.	SA 210 Gr. A1	YELLOW		
24.	SA 210 Gr. C	BLUE		
25.	SA 213 Gr. T11	ALUMINIUM	YELLOW	
26.	SA 213 Gr. T12	BROWN	YELLOW	
27.	SA 213 Gr. T2	BROWN	GREEN	
28.	SA 213 Gr. T22	GREEN	RED	
29.	SA 213 Gr. T23	RED	WHITE	
30.	SA 213 Gr. T5	BLACK	BROWN	GREEN
31.	SA 213 Gr. T9	BROWN	WHITE	
32.	SA 213 Gr. T91	GREEN	YELLOW	
33.	SA 213 Gr. T92	BROWN	BLUE	
34.	SA 213 Gr. TP 304	BLUE	GREEN	YELLOW
35.	SA 213 Gr. TP 304H	BLACK	BLUE	YELLOW
36.	SA 213 Gr. TP 304L	BLUE	WHITE	YELLOW
37.	SA 213 Gr. TP 309H	BLACK	BROWN	YELLOW
38.	SA 213 Gr. TP 316	BROWN		
39.	SA 213 Gr. TP 316 Ti	BLACK	BLUE	
40.	SA 213 Gr. TP 316L	BLUE	BROWN	YELLOW
41.	SA 213 Gr. TP 321	BLUE	WHITE	
42.	SA 213 Gr. TP 321H	BLACK	WHITE	
43.	SA 213 Gr. TP 347H	BLACK	YELLOW	

Sl. No.	Specification	Colour 1	Colour 2	Colour 3
44.	SA 268 Gr. TP 405	ALUMINIUM	GREEN	
45.	SA 268 Gr. TP 410	BROWN	RED	YELLOW
46.	SA 268 Gr. TP 443	BLUE	GREEN	WHITE
47.	SA 269 TP 316	GREEN	RED	YELLOW
48.	SA 312 Gr. TP 304	BLUE	YELLOW	
49.	SA 312 Gr. TP 304L	BLUE	RED	YELLOW
50.	***SA 312 Gr. TP 304H***	***BLACK***	***BLUE***	***YELLOW***
51.	SA 312 Gr. TP 316	BLACK	GREEN	
52.	SA 312 Gr. TP 316L	BLACK	BLUE	BROWN
53.	SA 312 Gr. TP 321	BLUE	BROWN	
54.	SA 312 Gr. TP 347	BLUE	RED	WHITE
55.	SA 333 Gr. 1	BLACK	BROWN	RED
56.	SA 333 Gr. 3	BLACK	GREEN	RED
57.	SA 333 Gr. 6	BLUE	GREEN	RED
58.	SA 334 Gr. 1	BROWN	GREEN	RED
59.	SA 334 Gr. 3	BLACK	RED	YELLOW
60.	SA 334 Gr. 6	BLACK	BLUE	RED
61.	SA 335 Gr. P1	BROWN	GREEN	YELLOW
62.	SA 335 Gr. P11	GREEN	WHITE	
63.	SA 335 Gr. P12	BLACK	RED	
64.	SA 335 Gr. P2	BLUE	BROWN	GREEN
65.	SA 335 Gr. P22	BLUE	RED	
66.	SA 335 Gr. P23	RED	WHITE	
67.	SA 335 Gr. P5	BLACK	BROWN	
68.	SA 335 Gr. P9	ALUMINIUM	BROWN	
69.	SA 335 Gr. P91	BROWN	RED	
70.	SA 335 Gr. P92	BROWN	BLUE	
71.	SB 163 Inconel	BLACK	GREEN	YELLOW
72.	ST 35.4	ALUMINIUM	BLUE	
73.	Steel 20	GREEN		
74.	Structural Tubes & Pipes	BLUE	BROWN	WHITE
75.	X20 Cr Mo V 121	BLACK		
76.	SA 213 UNS S30432(Super 304)	BLACK	RED	GREEN

@@@@@@@@@@

ANNEXURE - V

Technical: Seamless Tubes & Pipes Suppliers (Carbon / Alloy / Stainless Steel) Supplier Facility Report

1. Name of the Company

2. Address of the Registered Office (Telephone, E-Mail, Fax)

3. Factory Location and Address (Telephone, E-Mail, Fax)

4. **Installed Capacity (Tonnes / Year)**

4.1) Carbon Steel

a) SA 192

b) SA 210 Gr. A1, C

c) SA 106 Gr. B, C

d) Riffled Tube / SA 210 Gr. C

4.2) Alloy Steel

a) SA 335 P11, P12, P22

b) SA 213 T11, T22

c) SA 335 P91, SA 213 T91

d) SA 335 P23, P92

e) SA 213 T23, T92

f) Riffled Tube / SA 213 T12, T22, T23

4.3) Stainless Steel

a) SA 213 TP 304H

b) SA 213 TP 347H

c) SA 213 TP 347HFG

d) Super 304H

5. **Are you making your own steel (Bloom) for making Tubes / Pipes ?** YES ☐ NO ☐

6. If yes, for Sl. No. 5

   a) Type of Furnace

   b) Capacity of furnaces (Metric Tonnes / Melt)

   c) Facility for manufacture of Blooms

7. If No, for Sl. No. 5

   a) Source of Raw Material (Blooms)

8. **Tube / Pipe Manufacturing Facility details**

   8.1 Capacity of the rolling mill with respect to Diameter (Minimum and Maximum), Thickness (Minimum and Maximum) and Length (Maximum)

   a) Through Hot Finishing

   b) Through Cold Finishing

   8.2 Type & Make of Hot Mill along with the details of the Individual Equipments

   8.3 Type & Make of Cold Mill along with the details of the Individual Equipments

9. **Heat Treatment Facility Details**

   a) Capacity of the Furnaces

   b) Type of Heat Treatment Carried out (Batch or Continuous)

10. **In House Testing Equipments Details**

   a) Online UT Facilities

   b) Online Eddy Current (EC) Facility

   c) Hydro Test Facilities (Indicate the Maximum Pressure)

   d) Chemical and Mechanical Testing Facilities

11. **Details of Accreditation for Quality Systems (Like ISO, ASME, API etc.,)**

12. Are you Approved by any Third Party / Statutory Agency ?
If so, specify the Agency **(Attach details in ENGLISH)**

13. Have you manufactured the following Size / Specification / Length to BHEL or any other well-known Boiler Manufacturer for Boiler Application
Please provide the details of to whom, when and how much supplied.

a) TUBES:

TUBES REQUIREMENT- LENGTH : 6500 mm to 13800 mm			
SL. NO.	**OUTER DIAMETER**	**WALL THICKNESS**	**SPECIFICATION**
1	21.3 to 73.01 mm	2.11 to 14.02 mm	SA 106 Gr B / Gr C (Carbon Steel) SA 335 P12, P22, P23, P91, P92 (Alloy Steel)
2	28.6 to 76.1 mm	3.2 to 12.5 mm	SA 192 / SA 210 Gr A1 / Gr C (Carbon Steel) SA 210 Gr. C (Rifle Tubes) SA 213 T12, T22, T23 (Alloy Rifle Tubes)
3	14 to 76.1 mm	3.2 to 12.5 mm	SA 213 T11, T22, T23, T91, T92 (Alloy Steel) SA 213 TP 304 H, TP 347 H, TP 347 HFG, Super 304 H (SS)

b) PIPES:

PIPES REQUIREMENT – LENGTH 3000 mm to 9000 mm			
SL. NO.	**OUTER DIAMETER**	**WALL THICKNESS**	**SPECIFICATION**
1	88.9 to 864.00 mm	3.96 to 148.0 mm	SA106 Gr B / Gr C (Carbon Steel)
2	88.9 to 965.00 mm	3.96 to 130.0 mm	SA335 P11, P12, P22, P23 (Alloy Steel)
3	127.0 to 812.8 mm	11.50 to 100.00 mm	SA335 P91, P92 (Alloy Steel)
4	88.9 to 323.9 mm	3.05 to 12.5 mm	SA312 TP304H, 321 H, 316 (SS)

14. Please go thro the attached **Technical Delivery Condition (TDC)** and give point-by-point confirmation.

a) For Tubes: TDC: 0:102, 0:105, 0:119

b) For Pipes: TDC: 0:101, TDG: 32, TDG: 100, TDG: 101, TDG: 26, TDG: 6876

PLACE :

DATE :

SIGNATURE WITH SEAL

NOTE: Enclose Additional Sheets / Annexures wherever required referring the Sl. No. of this format.

******

1.0 GENERAL

Materials: SA106GrB, Gr C; SA 335 P11, P12, P22, P91 & P92 (Code case: 2179).
This Technical Delivery Condition specifies the requirements in addition to ASME SA 106, SA 335.

2.0 BILLET / BLOOM REQUIREMENTS

The billets/blooms shall be fully killed and vacuum degassed. Ladle analysis is required for all steels.

Chemistry shall be controlled as given below for below specified grades. For all other grades, it shall be as per applicable material specifications:

Ladle Analysis:

SA 106 Gr B:	Carbon: 0.25% Max.
SA 106 Gr C:	Thickness ≤ 20mm Carbon: 0.25 Max.
	Thickness > 20mm Carbon: 0.30 Max.
SA335 GrP92:	Si: 0.10-0.50%; Ni: 0.30max and Cu: 0.25max

The billet/bloom shall conform to the chemical and process requirements of respective pipe specifications. The billet/bloom shall be sourced from IBR well-known steel makers or with inspection and certification by IBR authorized Inspecting Authority in case the mill is not approved by IBR. Mill test certificate shall be submitted to BHEL.

3.0 CHEMICAL COMPOSITION

Product analysis on pipes is required for all steels. Chemistry shall be controlled as per applicable material specifications and the elements including Carbon (for SA106 Gr-B&C), Si, Ni, & Cu (for SA335 Gr-P92) as indicated in Clause 2.0 above shall also be reported in the product analysis.

4.0 TOLERANCES : Unless otherwise specified in the PO, tolerances shall be as below:

4.1 OD specified pipes:-

SA335 P91& P92: the tolerance on OD shall be: ±1% (Max: 4mm) of Nominal OD.

Other than SA335 P91& P92: the tolerance on OD shall be: ±1% (Max: 6mm) of Nominal OD.

4.2 ID specified pipes are specified by the maximum Internal Diameter and Minimum wall thickness. The tolerance if not specified in the PO shall be: ID: +0.0mm, -3.2mm & Thickness: +6.4mm, -0.0mm

- Weight per meter : +10% , -5% on nominal weight **

** Nominal weight of ID Pipe per meter shall be calculated as follows,
Wtnom =(IDnom + tnom)*tnom*0.02466 kg/meter , where
ID nom = IDmax-1.6 mm ; tnom = tmin+3.2 mm

Actual weight per meter shall be indicated in mill test certificate.

5.0 STRAIGHTNESS & POLYGONIZATION

The Pipes shall not deviate from straightness by more than 1mm in any one meter and shall not be more than 6mm over the entire length for Pipes of OD > 76.1mm. A sharp bend at the end or kink and twist are not acceptable. These limitations are applicable for any given plane.
Also, for Pipes with OD ≤ 76.1mm, shall be made by processes specified below:

1. All pipes shall be cold formed in case of "t/D" ratios > 0.15, where "t" is the specified nominal wall thickness and "D" is the specified nominal OD of the pipe.
2. Pipes may be cold formed or hot formed in case of "t/D" ratios upto and including 0.15.
3. The degree of polygonization (P), measured as indicated in Fig.1 & calculated using the below formula, shall not exceed 15% in both the above cases:

$$P = \{[\sum S_B - \sum S_A] / [0.135*(3D - \sum S_A)]\} * 100$$

where, P is the degree of Polygonization in %
D is the specified nominal OD of the pipe
$\sum S_B$ is the sum of maximum pipe wall thicknesses measured at 6 locations 60 degrees apart and
$\sum S_A$ is the sum of minimum pipe wall thicknesses measured at 6 locations 60 degrees apart.

Wall thickness shall be measured using profile projector/shadowgraph/digital scanner/any other suitable instrument meant for this purpose.

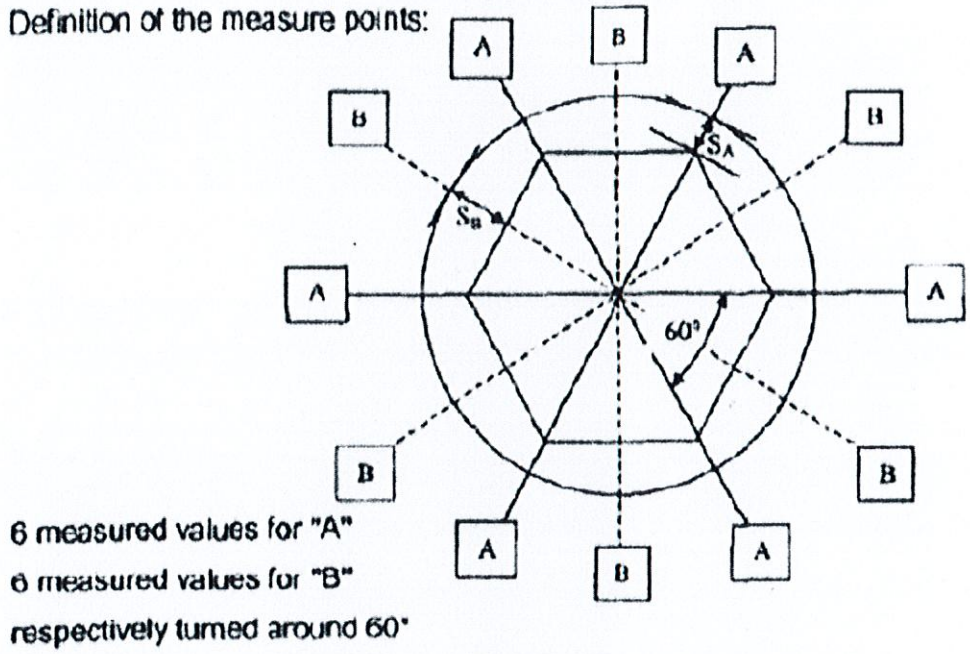

Fig. 1

6.0 HEAT TREATMENT & MECHANICAL TESTS

6.1 HEAT TREATMENT

CS: Hot Finished : OD <= 76.1mm no heat treatment required. OD > 76.1mm shall be in Normalised condition.
CS: Cold Finished : All Sizes – In Sub-critical annealed, fully annealed or in Normalised condition.
AS: All sizes – SA335 P11, P12 & P22 – Either in Normalised and tempered or Isothermal Annealed condition.
AS: All sizes – SA335 P91 & P92: Shall be Normalised as per specification & Tempered between 750°C-780°C.

6.2 MECHANICAL TESTS:

As per specification. Quantum of test: As per specification – For each nominal size per heat per heat treatment batch. (Minimum 2 pipes for first 100 pipes and 1 per 100 or part thereof for pipes over 100 numbers, as per IBR). For alloy steel pipes meant for fitting (As indicated in the Purchase order), test coupon shall be in normalised and tempered condition.

For P91 Pipes, Ys (0.2% offset) - 450 MPa Min ; Ts – Min 630 MPa, Max 850 MPa.
For P92 pipes Ts- Min 630 Mpa, Max 850 Mpa.
For other grades, Ys and Ts shall be as per specifications.

6.3 HARDNESS FOR SA 335 P91 & P92 PIPES :

Hardness test shall be carried out on each pipe. The hardness value for P91 shall be 195-250 BHN and that for P92 shall be 190-250 BHN. The hardness test values shall be indicated in the Test certificate

7.0 SUPPLEMENTARY TESTS

These are applicable to SA 106 Cr C, SA335 P11, P12, P22, P91 & P92. The supplementary test results shall be indicated in the Test Certificate along with the mandatory test results.

7.1. **Product Analysis (S1):-** Product Analysis for all steels shall be carried out on 5% of pipes per heat per heat treatment batch (minimum 2 Nos) for size NB 200 mm and above.

7.2. **Transverse tension test (S2):-** Transverse tension test shall be carried out (for size NB 200 mm and above) on one end of 5% of pipes per heat per heat treatment batch (minimum 1 No).

7.3. **Photomicrograph test for P91 & P92 (S5):-** Photomicrograph test shall be carried out from a specimen of pipe in the as finished condition for each individual size (OD and wall thickness) per heat per heat treatment batch. Acceptance norms - The Material shall be free from any micro fissures. Microstructure shall show tempered martensite and also to be examined for any grain growth and delta ferrite (to be maintained within 3% for Gr92 and within 2% for Gr91 when measured as per VD TUV 1272). Photomicrograph with 400x (Min) magnification along with Photomicrograph report to be provided. The actual magnification shall be indicated.

7.4. **Project specific requirement for any other supplementary test as indicated in respective material specification shall be addressed separately in Enquiry / Purchase order.**

8.0 NON DESTRUCTIVE TEST

Each pipe shall be ultrasonically tested as per ASTM E 213 in both clockwise & anticlockwise directions; calibration to be done on two axial notches of 50 mm length (inside & outside) and a depth of 5% of wall thickness (minimum 0.3 mm; maximum 1.5mm). The results shall be indicated in the Test Certificate.

9.0 REPAIR

Repair by welding is prohibited. The pipe shall meet the dimensional tolerance (clause 3.0 above) after any mechanical repair as permitted in the standard.

10.0 WORKMANSHIP

The Inside & outside surfaces of the pipes shall be free from any imperfections & defects like laps,seams,folds, cracks, pitting etc,. Localised imperfections, if any,may be removed by grinding or skin machining only, ensuring the wall thickness, inside and outside diameter to provide workmanship like finish. Local depressions or ground spots are not acceptable. Loose scales shall be removed by blast cleaning in both inside and outside surface. Repair by welding is prohibited.

11.0 MARKING & COLOUR CODING

The following details are to be marked on the consignment for identification

1) PO Number 2) Supplier's emblem/code 3) Specification & grade (Code Case if applicable) 4) Heat number
5) Size (OD/ID X Thickness X Length, in mm) 6) No. of pipes 7) Inspector's seal

OD up to 31.8 mm (excluding)	Details 1 to 7 shall be stamped on metal / plastic tag attached to bundle
OD 31.8 mm to OD 76.1mm (including)	Details 1 to 5 shall be paint stencilled on each pipe. Details1 to 7 to be stamped on Metal / Plastic tag attached to bundle.
OD above 76.1 mm	Details 2,3,4,5 & 7 shall be hard stamped with round edged stamp at 100mm from an end of each pipe. Details 1 to 5 shall be paint stencilled on each pipe.

Longitudinal colour bands on the entire length of all pipes. The colours shall be as per BHEL procedure SIP: PP: 21(Latest).

12.0 PRESERVATION

- Outside: - Resin type rust preventive coating with visibility to stencilled details. Thick Black coating which camouflages the Surface of the pipes is not permitted.
- Inside: - Rust inhibitor or resin type rust preventive coating.
- Ends of the pipes shall be secured with caps.

13.0 PACKING

a) Thickness</=2.5mm in boxes. b) OD </= 159 mm in bundles. Others in loose condition.
Pipe bundles to be < 4 tons of equal no.of pipes, fastened with galvanised strap/ anti-rust coated (1x25mm.min.) for Carbon Steel & Alloy Steel and by Nylon strap for Stainless Steel at 2 ends & at 1m interval. Wooden pallets to cover pipes are not permitted.

14.0 INSPECTION AND CERTIFICATION (In English Only)

14.1. Products shall be inspected at works and the applicable IBR Forms must be Countersigned by the Inspecting Authority as indicated below:

a) Imported Items: Inspecting Authority approved by IBR for the Country of origin (To be concurred by BHEL before placing PO).

b) Indigenously Supplied items: Director/Chief Inspector of Boilers of respective State.

14.2. Certification in IBR Form-IIIA for Pipes & IBR Form-IV for the raw material steel from "IBR-Well Known Pipe Maker" or "Inspecting Authority" as applicable, to be submitted.

14.3. Test Certificate shall include PO no.(BHEL), TDC no., Pipe size and quantity- melt wise, specification and grade with year of code, Heat no., Steel &Pipe making process, chemistry including incidental elements on Ladle and Product analysis, Heat treatment details with actual temperature and soaking time, Mechanical results.

14.4. Detailed NDT reports with reference norms, acceptance standards and test results shall be furnished along with Test certificates.

14.5. For P91 & P92 pipes the Photomicrograph test report along with photomicrograph with 400x (min) magnification shall be furnished.

14.6. Refer to BHEL Engineering Drawing: 4-03-000-00062 (Latest Rev) for MAWP values for various material grades & sizes at various temperatures.

14.7. ***Mill test certificate of the raw material (billet/bloom) as per Cl.2.0***

15.0 End Use : These pipes are meant for use in subcritical and supercritical Boilers. These pipes shall be capable of undergoing forming, bending and welding operations necessary for the application without developing defects.

RECORDS OF REVISIONS

i) Rev 03 – Para 4.1, 4.2.b are included; Para 6.0, 13.0 are modified

ii) Rev 04 – Para 3.1, 3.2 modified

iii) Rev 05 – SA335 P92 included. Para 1.0, 2.0, 4.1, 4.2, 5.0, 6.0 are modified & Para 5.3, 13.4 included.

iv) Rev 06 – Para 4.0 added. Para 1.0, 3.1, 3.2, 4.1, 5.1, 5.2, 6.1, 6.2, 6.3, 9.0, 10.0, 11.0 & 12.1 revised and further Clauses renumbered.

v) Rev 07 – Para 3.2 revised w.r.t. thickness tolerance for ID specified pipes.

vi) Rev 08 – Para 12.0 added and further clauses renumbered.
Para 5.2, 5.3 & 6.3 revised.
Para 13.1 & 13.2 are revised as per IBR amendment dt :15-Apr-2015.

vii) Rev 09 – Para 3.1& 5.1 revised.

viii) Rev 10 – Para 2.1, 2.2, 2.3, 4.0 (Polygonization), 5.4(Creep Test), 6.4, 13.6 & 13.7 added.
Para 9.0, 10.0 & 13.2 revised

ix) Rev 11 – Para 5.4 & 13.6 - Creep Test requirements removed and further clauses renumbered.

x) Rev 12 – Para 2.0 for Billet/Bloom requirements added and further clauses renumbered.
Para 3.0, 10.0 are revised & 14.7 added.

xi) Rev 13 – Para 2.0 modified based on feedback from user departments, suppliers and internal discussions, Para 15.0 added

J Nanthini/ QA	D Sandra Priya / QA	R Prabha / MM	C Vaithiananthan / Engg	K V Ramani / Quality
Prepared by	Reviewed by			Approved by

1.0 SCOPE :-

1.1 The seamless steel pipes shall meet the requirements of ASME SA 106 Gr B, Gr C, SA 335 Gr P11, P22, P91, P92 and SA 312 TP 321 as applicable.

2.0 DIMENSIONS:-

The pipe dimension: Unless otherwise specified in the PO, tolerances for OD pipes shall be as below

a) SA335 P91 / 92: the tolerance on OD shall be: ±1% (Max: 4mm) of Nominal OD.
b) Other than SA335 P91: the tolerance on OD shall be: ±1% (Max: 6mm) of Nominal OD.
c) Tolerance on Thickness : ±12.5% of the specified thickness

3.0 CHEMICAL COMPOSITION :-

3.1 Product analysis (in addition to laddle Analysis) shall be carried out on one pipe per melt for all steels.

Chemistry shall be controlled as given below for specific grades. For all other grades as per the applicable material specification

SA 106 Gr B : Carbon : 0.25 Max,
SA 106 Gr C : Thickness </= 20mm, Carbon : 0.25 Max
SA 106 Gr C : Thickness > 20mm, Carbon : 0.30 Max
SA335 Gr P92 : Si:0.10-0.50, Ni : 0.30 max, Cu : 0.25 max

3.2 The billet and bloom shall be fully killed and vacuum degassed. The billet/ bloom shall be sourced from well known steel makers. Mill test certificates shall be submitted to BHEL.

4.0 STRAIGHTNESS & POLYGONIZATION :-

The Pipes shall not deviate from straightness by more than 1mm in any one meter and shall not be more than 6mm over the entire length for Pipes of OD > 76.1mm. A sharp bend at the end or kink and twist are not acceptable. These limitations are applicable for any given plane.

Also, for Pipes with OD ≤ 76.1mm, shall be made by processes specified below:

1. All pipes shall be cold formed in case of "t/D" ratios > 0.15, where "t" is the specified nominal wall thickness and "D" is the specified nominal OD of the pipe.

2. Pipes may be cold formed or hot formed in case of "t/D" ratios upto and including 0.15.
3. The degree of polygonization (P), measured as indicated in Fig.1 & calculated using the below formula, shall not exceed 15% in both the above cases:

$$P = \{[\sum SB - \sum SA] / [0.135*(3D - \sum SA)]\} * 100$$

where, P is the degree of Polygonization in %
D is the specified nominal OD of the pipe
$\sum$ SB is the sum of maximum pipe wall thicknesses measured at 6 locations 60 degrees apart and
$\sum$ SA is the sum of minimum pipe wall thicknesses measured at 6 locations 60 degrees apart.

Wall thickness shall be measured using profile projector/shadowgraph/digital scanner/any other suitable instrument meant for this purpose.

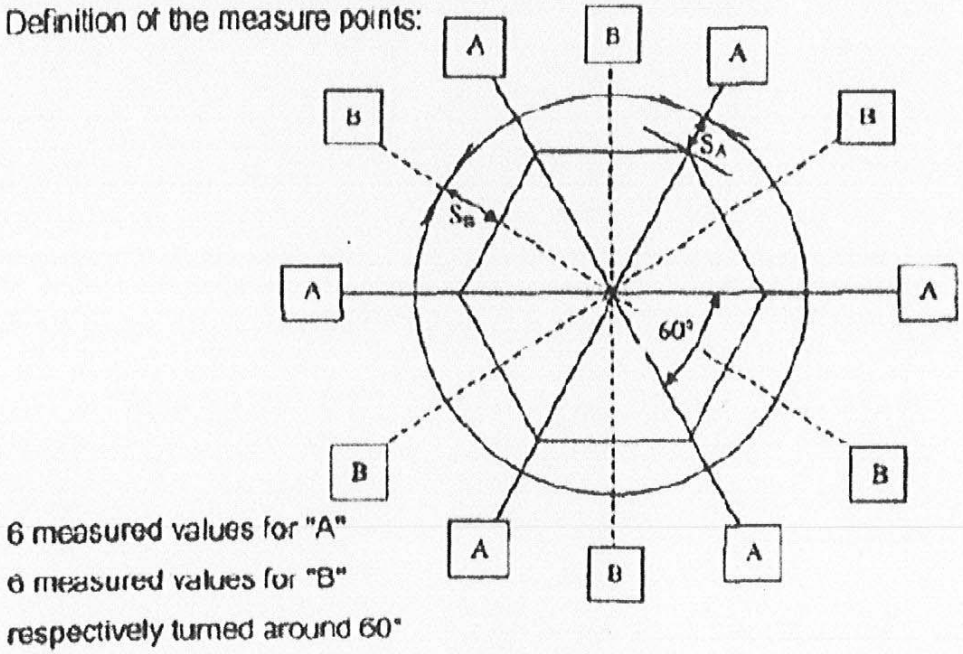

Fig. 1

5.0 **HEAT TREATMENT :-**

Heat Treatment shall be done as mentioned in the ASME standard, for the material specification as detailed in BHEL drawing.

5.1 SA 312 - Solution treated as per SA 312 std.

6.0 **MECHANICAL TEST :- (Including Flattening / Bend Test as applicable)**

6.1 The pipes shall be subjected to mechanical tests as per SA 106, SA 335 & SA 312 as Applicable.

6.2 Quantum of test : As per specification.

6.3 **HARDNESS TEST**

Hardness test shall be carried out on each pipe.
The hardness value for P91 shall be 195-250 BHN, P92 shall be 190-250 BHN
The hardness test values shall be indicated in the Test certificate

7.0 **HYDROSTATIC TEST :-**

7.1 All Pipes with working / operating pressure lesser than 70 bar must be Hydro tested at pressure mentioned in BHEL drawing.

8.0 **NON-DESTRUCTIVE TEST :-**

8.1 All Pipes with working / operating temperature greater than 400°C and/or design pressure greater than 70 bar must be 100% UT tested.

9.0 **REPAIR :-**

9.1 Repair by welding is prohibited.

9.2 After mechanical repairing all tolerances to be met.

10.0 **WORKMANSHIP**

10.1 All pipes shall have smooth surfaces, free of any defect/scale and all SA106, SA335 pipes shall be protected with translucent rust preventive on the outside and rust inhibitor inside.

All SA 312 pipes shall be supplied in pickled & passivated condition only. No rust inhibiter is required to protect the pipe inside.

10.2 Ends shall be capped tight.

11. MARKING

Description	For Pipes of OD (in mm)		
	OD > 73.0	OD 33.4 - 73.0	OD < 33.4
1) P.O.No	A	A & C	C
2) Size	A&B	A & C	C
3) Quanlity (Nos)	--	A & C	C
4) Specification	A&B	A & C	C
5) Grade	A&B	A & C	C
6) Marker's Mark	A&B	A & C	C
7) Melt Number	A&B	A & C	C
8) Inspector's seal	B	C	C

A- Paint Stencil on Pipe.
B- Hard Punch on Pipe 100mm away from both ends & etch on SS pipes.
C- Hard Punch on Metal Tag (Aluminium or Stainless Steel) and secure by metal wire to Pipe/Bundle.

12.0 **COLOUR CODE**:- Each pipe shall be colour coded longitudinally.

12.1

SA 106 Gr. B / C	Red
SA 335 Gr. P11	Yellow
SA 335 Gr. P22	Green
SA 335 Gr. P91	Blue
SA 335 Gr. P92	Purple
SA 312 TP 321	Pink

13.0 PACKING:-

OD in mm	t in mm	TYPE OF PACKING
All Pipes	UP TO 3.2mm	BOXES
LESS THAN 88.9	ALL	BUNDLES
88.9 TO 168.3	UP TO 7.11	BUNDLES
	ABOVE 7.11	LOOSE
ABOVE 168.3	ALL	LOOSE

13.1 **BUNDLES**:-

A bundle shall weigh less than 2 tonnes & shall be strapped with galvanised steel strap/wire at both ends at every one meter interval.

13.2 **BOXES**:-

Boxes shall be made of wood with arrests at proper location so as to avoid any dent and other damages during transit.

14.0 **INSPECTION & CERTIFICATES**:-

14.1 All pipes shall be inspected at works by Inspection agencies/authorities as indicated in the P.O. Mill Test Certificates shall be countersigned by above authority and shall include the following.

1. Purchase Order No.(BHEL).TDC No. & Test Certificate number, Size & Quantity – meltwise.
2. Specification and Grade with year of code, Heat Number, steel & Pipe making process.
3. Chemistry including incidental elements – Laddle and product analysis.
4. Heat treatment details, Mechanical test results, NDE results with reference ,acceptance standard.
5. Hydrostatic test Pressure & Result.
6. Surface treatment details.

15.0 Details not covered in this TDG, shall be complied with as per the applicable ASME standards.

16.0 RECORDS OF REVISIONS

Rev 00 – Prepared for Turbine Integral piping

Rev 01 – Inclusion of Pipe Grade P91 and P92 and general revision to comply to BHEL HEEP Specification ST 34001 Rev 08.

1.0 GENERAL

Materials: SA106GrB, Gr C; SA 335 P11, P12, P22, P91 & P92 (Code case: 2179).
This Technical Delivery Condition specifies the requirements in addition to ASME SA 106, SA 335.

2.0 BILLET / BLOOM REQUIREMENTS

The billets/blooms shall be fully killed and vacuum degassed. Ladle analysis is required for all steels. Chemistry shall be controlled as given below for below specified grades. For all other grades, it shall be as per applicable material specifications:

Ladle Analysis:

SA 106 Gr B:	***Carbon: 0.25% Max.***
SA 106 Gr C:	***Thickness ≤ 20mm Carbon: 0.25 Max.***
	Thickness > 20mm Carbon: 0.30 Max.
SA335 GrP92:	***Si: 0.10-0.50%; Ni: 0.30max and Cu: 0.25max***

The billet/bloom shall conform to the chemical and process requirements of respective pipe specifications. The billet/bloom shall be sourced from IBR well-known steel makers or with inspection and certification by IBR authorized Inspecting Authority in case the mill is not approved by IBR. Mill test certificate shall be submitted to BHEL.

3.0 CHEMICAL COMPOSITION

Product analysis on pipes is required for all steels. Chemistry shall be controlled as per applicable material specifications and the elements including Carbon (for SA106 Gr-B&C), Si, Ni, & Cu (for SA335 Gr-P92) as indicated in Clause 2.0 above shall also be reported in the product analysis.

4.0 TOLERANCES : Unless otherwise specified in the PO, tolerances shall be as below:

4.1 OD specified pipes:-
SA335 P91& P92: the tolerance on OD shall be: ±1% (Max: 4mm) of Nominal OD.

Other than SA335 P91& P92: the tolerance on OD shall be: ±1% (Max: 6mm) of Nominal OD.

4.2 ID specified pipes are specified by the maximum Internal Diameter and Minimum wall thickness. The tolerance if not specified in the PO shall be: ID: +0.0mm, -3.2mm & Thickness: +6.4mm, -0.0mm

- Weight per meter : +10% , -5% on nominal weight **

** Nominal weight of ID Pipe per meter shall be calculated as follows,
Wtnom =(IDnom + tnom)*tnom*0.02466 kg/meter , where
ID nom = IDmax-1.6 mm ; tnom = tmin+3.2 mm

Actual weight per meter shall be indicated in mill test certificate.

5.0 STRAIGHTNESS & POLYGONIZATION

The Pipes shall not deviate from straightness by more than 1mm in any one meter and shall not be more than 6mm over the entire length for Pipes of OD > 76.1mm. A sharp bend at the end or kink and twist are not acceptable. These limitations are applicable for any given plane.
Also, for Pipes with OD ≤ 76.1mm, shall be made by processes specified below:

1. All pipes shall be cold formed in case of "t/D" ratios > 0.15, where "t" is the specified nominal wall thickness and "D" is the specified nominal OD of the pipe.
2. Pipes may be cold formed or hot formed in case of "t/D" ratios upto and including 0.15.
3. The degree of polygonization (P), measured as indicated in Fig.1 & calculated using the below formula, shall not exceed 15% in both the above cases:

$$P = \{[\sum S_B - \sum S_A] / [0.135*(3D - \sum S_A)]\} * 100$$

where, P is the degree of Polygonization in %
D is the specified nominal OD of the pipe
$\sum S_B$ is the sum of maximum pipe wall thicknesses measured at 6 locations 60 degrees apart and
$\sum S_A$ is the sum of minimum pipe wall thicknesses measured at 6 locations 60 degrees apart.

Wall thickness shall be measured using profile projector/shadowgraph/digital scanner/any other suitable instrument meant for this purpose.

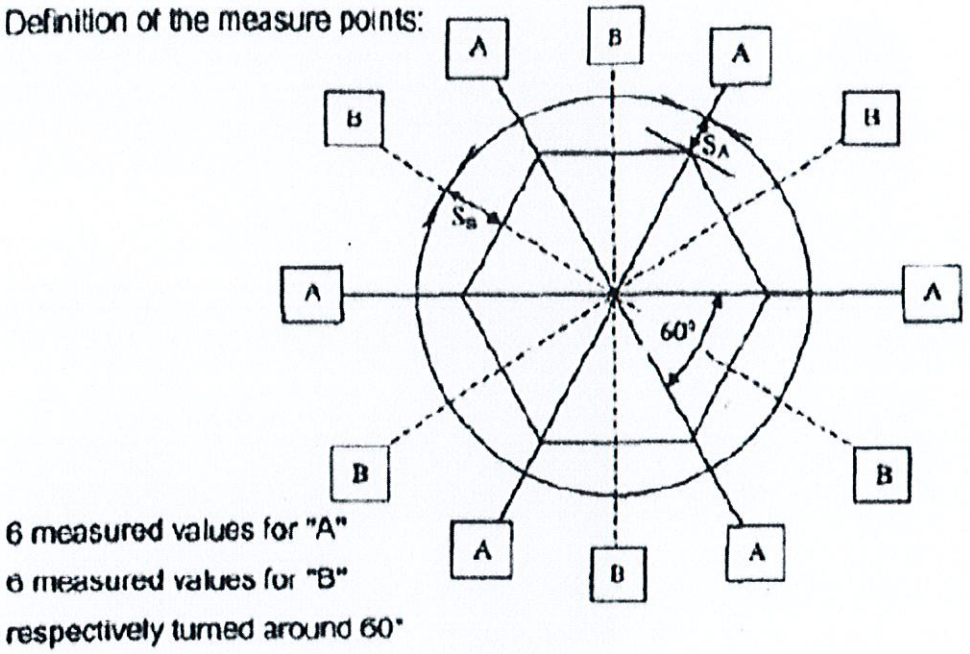

Fig. 1

6.0 HEAT TREATMENT & MECHANICAL TESTS

6.1 HEAT TREATMENT

CS: Hot Finished : OD <= 76.1mm no heat treatment required. OD > 76.1mm shall be in Normalised condition.
CS: Cold Finished : All Sizes – In Sub-critical annealed, fully annealed or in Normalised condition.
AS: All sizes – SA335 P11, P12 & P22 – Either in Normalised and tempered or Isothermal Annealed condition.
AS: All sizes – SA335 P91 & P92: Shall be Normalised as per specification & Tempered between 750°C-780°C.

6.2 MECHANICAL TESTS:

As per specification. Quantum of test: As per specification – For each nominal size per heat per heat treatment batch. (Minimum 2 pipes for first 100 pipes and 1 per 100 or part thereof for pipes over 100 numbers, as per IBR). For alloy steel pipes meant for fitting (As indicated in the Purchase order), test coupon shall be in normalised and tempered condition.

For P91 Pipes, Ys (0.2% offset) - 450 MPa Min ; Ts – Min 630 MPa, Max 850 MPa.
For P92 pipes Ts- Min 630 Mpa, Max 850 Mpa.
For other grades, Ys and Ts shall be as per specifications.

6.3 HARDNESS FOR SA 335 P91 & P92 PIPES :

Hardness test shall be carried out on each pipe. The hardness value for P91 shall be 195-250 BHN and that for P92 shall be 190-250 BHN. The hardness test values shall be indicated in the Test certificate

7.0 SUPPLEMENTARY TESTS

These are applicable to SA 106 Cr C, SA335 P11, P12, P22 and P91. The supplementary test results shall be indicated in the Test Certificate along with the mandatory test results.

7.1. **Product Analysis (S1):-** Product Analysis for all steels shall be carried out on 5% of pipes per heat per heat treatment batch (minimum 2 Nos) for size NB 200 mm and above.

7.2. **Transverse tension test (S2):-** Transverse tension test shall be carried out (for size NB 200 mm and above) on one end of 5% of pipes per heat per heat treatment batch (minimum 1 No).

7.3. **Photomicrograph test for P91 & P92 (S5):-** Photomicrograph test shall be carried out from a specimen of pipe in the as finished condition for each individual size (OD and wall thickness) per heat per heat treatment batch. Acceptance norms - The Material shall be free from any micro fissures. Microstructure shall show tempered martensite and also to be examined for any grain growth and delta ferrite (to be maintained within 3% for Gr92 and within 2% for Gr91 when measured as per VD TUV 1272). Photomicrograph with 400x (Min) magnification along with Photomicrograph report to be provided. The actual magnification shall be indicated.

7.4. **Supplementary and Additional requirements for P92:-** Supplementary tests S1 Product Analysis, S2 Transverse Tension test, S3 Flattening test and S4 Metal Structure& Etching test as per ASTM A 335 shall be done. Quantum of tests shall be at least 5% of the pipes per heat or Minimum 2 pipes per heat from one end / both end of the pipe as specified in ASTM A335. S5 Photomicrograph test requirement shall be as per Clause 7.3.

8.0 NON DESTRUCTIVE TEST

Each pipe shall be ultrasonically tested as per ASTM E 213 in both clockwise & anticlockwise directions; calibration to be done on two axial notches of 50 mm length (inside & outside) and a depth of 5% of wall thickness (minimum 0.3 mm; maximum 1.5mm). The results shall be indicated in the Test Certificate.

9.0 REPAIR

Repair by welding is prohibited. The pipe shall meet the dimensional tolerance (clause 3.0 above) after any mechanical repair as permitted in the standard.

10.0 WORKMANSHIP

The Inside & outside surfaces of the pipes shall be free from any imperfections & defects like laps,seams,folds, cracks, pitting etc,. Localised imperfections, if any,may be removed by grinding or skin machining only, ensuring the wall thickness, inside and outside diameter to provide workmanship like finish. Local depressions or ground spots are not acceptable. Loose scales shall be removed by blast cleaning in both inside and outside surface. Repair by welding is prohibited.

11.0 MARKING & COLOUR CODING

The following details are to be marked on the consignment for identification

1) PO Number 2) Supplier's emblem/code 3) Specification & grade (Code Case if applicable) 4) Heat number
5) Size (OD/ID X Thickness X Length, in mm) 6) No. of pipes 7) Inspector's seal

OD up to 31.8 mm (excluding)	Details 1 to 7 shall be stamped on metal / plastic tag attached to bundle
OD 31.8 mm to OD 76.1mm (including)	Details 1 to 5 shall be paint stencilled on each pipe. Details1 to 7 to be stamped on Metal / Plastic tag attached to bundle.
OD above 76.1 mm	Details 2,3,4,5 & 7 shall be hard stamped with round edged stamp at 100mm from an end of each pipe. Details 1 to 5 shall be paint stencilled on each pipe.

Longitudinal colour bands on the entire length of all pipes. The colours shall be as per BHEL procedure SIP: PP: 21(Latest).

12.0 PRESERVATION

- Outside: - Resin type rust preventive coating with visibility to stencilled details. Thick Black coating which camouflages the Surface of the pipes is not permitted.
- Inside: - Rust inhibitor or resin type rust preventive coating.
- Ends of the pipes shall be secured with caps.

13.0 PACKING

a) Thickness</=2.5mm in boxes. b) OD </= 159 mm in bundles. Others in loose condition.
Pipe bundles to be < 4 tons of equal no.of pipes, fastened with galvanised strap/ anti-rust coated (1x25mm.min.) for Carbon Steel & Alloy Steel and by Nylon strap for Stainless Steel at 2 ends & at 1m interval. Wooden pallets to cover pipes are not permitted.

J Nanthini / QA	D Sandra Priya/ QA	R Prabha / MM	C. Vaithianathan / Engg	K V Ramani / Quality
Prepared by	Reviewed by			Approved by

14.0 INSPECTION AND CERTIFICATION (In English Only)

14.1. Products shall be inspected at works and the applicable IBR Forms must be Countersigned by the Inspecting Authority as indicated below:
a) Imported Items: Inspecting Authority approved by IBR for the Country of origin (To be concurred by BHEL before placing PO).
b) Indigenously Supplied items: Director/Chief Inspector of Boilers of respective State.

14.2. Certification in IBR Form-IIIA for Pipes & IBR Form-IV for the raw material steel from "IBR-Well Known Pipe Maker" or "Inspecting Authority" as applicable, to be submitted.

14.3. Test Certificate shall include PO no.(BHEL), TDC no., Pipe size and quantity- melt wise, specification and grade with year of code, Heat no., Steel &Pipe making process, chemistry including incidental elements on Ladle and Product analysis, Heat treatment details with actual temperature and soaking time, Mechanical results.

14.4. Detailed NDT reports with reference norms, acceptance standards and test results shall be furnished along with Test certificates.

14.5. For P91 & P92 pipes the Photomicrograph test report along with photomicrograph with 400x (min) magnification shall be furnished.

14.6. Refer to BHEL Engineering Drawing: 4-03-000-00062 (Latest Rev) for MAWP values for various material grades & sizes at various temperatures.

14.7. ***Mill test certificate of the raw material (billet/bloom) as per Cl.2.0***

15.0 End Use : These pipes are meant for use in subcritical and supercritical Boilers. These pipes shall be capable of undergoing forming, bending and welding operations necessary for the application without developing defects.

RECORDS OF REVISIONS

i) Rev 01 – Para 2.0 modified based on feedback from user departments, suppliers and internal discussions, Para 15.0 added

J Nanthini / QA	D Sandra Priya/ QA	R Prabha / MM	C. Vaithianathan / Engg	K V Ramani / Quality
Prepared by	Reviewed by			Approved by