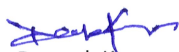
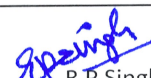


<u>Pre-Qualifying Requirement (PQR)</u>		<u>TTX/PQR/2025/133</u>
For Rough Vertical & Horizontal Machining of IP Inner Casing (Drg. no. - 01060230000)		<u>Rev:01</u>
SL. No.	REQUIREMENT	REMARKS
1	Only those vendors who have the following machines and facilities installed and operational at their works for machining & fitting operations of "IP Inner Casing" are requested to submit their quotes. The applicable details for these operations are as follows : (i) For Finish Machining, drawing number- 01060230000 (Sheet 1, 2 & 3) and for Groove Plan machining, drawing number- 91020430052 (Sheet 1 & 2) shall be applicable. (ii) The raw material casting halves as per casting drg no 01060230902, will be supplied to the vendor for Rough Vertical and Horizontal machining of IPIC after carrying out the control markings at BHEL Haridwar. (iii) Vendor to carry out the machining work as per Technical Delivery Condition (TDC) and drawing provided. Vendor to provide point wise acceptance of TDC terms with their offer.	Vendor to note & confirm. Also vendor to provide the point wise acceptance of TDC each terms.
2	Vendor must have suitable toolings / facility such as Marking Table / Machine Bed etc. in good working condition, to facilitate marking / transfer marking of job (as required). Vendor must have suitable facility for lifting / handling the subject job.	Vendor to confirm.
3	Horizontal Boring work :-	
3.1	Vendor must have CNC Horizontal Boring machine , suitable for machining of Joint Plane, joint plane holes, Back counters, Threaded holes of IP Inner Casing as per drawing & T.R.'s requirement. Machine Requirement : (a)X traverse : 3500 mm or more. (b)Y traverse : 4000 mm or more. (c)Ram + Spindle movement in Z direction : 1000 mm or more. (d)Rotary Table: 3000 mm x 3000 mm or more. (e)Weight capacity : 40 tons or more.	(a) Vendor to confirm. (b) Vendor to provide machine details / specification for referred operation.
4	Rough Turning /Rough Groove Plan Machining :-	(a) Vendor to confirm. (b) Vendor to provide
4.1	Vendor must have CNC Vertical Boring Machine , suitable for Rough Vertical Boring of IP Inner Casing as per drawing & T.R.'s requirement. Machine Requirement : (a) Table diameter of machine = 4000 mm or more. (b) Maximum Turning Height of job = 4000 mm or more. (c) Boring depth =2000 mm or more (d) Maximum weight capacity of machine = 75500 kg or more.	
OR		
4.2	Vendor must have CNC Gantry Milling Machine , suitable for Rough Turning /Rough Groove Plan Machining of IP Inner Casing as per drawing & T.R.'s requirement. Machine Requirement : (a) Distance between column : 4000 mm or more (b) Gantry Table to crossrail height : 2000mm or more (c) Machine Bed should be suitable to accommodate the job having weight capacity 40 Tons or more. (d) Machine should have suitable heads for machining bore depth and dia as per drawing.	(a) Vendor to confirm. (b) Vendor to provide machine details / specification for referred operation.
OR		
4.3	Vendor must have Stub Borer Machine , suitable for Rough Turning /Rough Groove Plan Machining of IP Inner Casing as per drawing & T.R.'s requirement. Machine Requirement : (a) Machine Bed should be suitable to accommodate the job in assembled conditioned having weight capacity 75500 kg or more. (b) Machine should have Boring & facing head facility suitable for machining bore depth and dia as per drawing.	

5	Fitting work :-	
5.1	Vendor must have suitable facility / arrangement for different fitting / assembly works to be done as per drawing & TR.	Vendor to confirm.
6	Vendor to confirm that above machines (as per pt. no. 3 & 4) are available at their works & are in good working condition with capability of achieving accuracies, surface finish & tolerances as per drawing requirements. If necessary, Vendor can suggest alternate machines (other than specified in pt. no. 3 & 4) for machining job with accuracies, surface finish & tolerances as per drawing, for review & acceptance by BHEL.	Vendor to confirm & submit the machine accuracies & Geometry details along with specification.
7	Vendor to submit Geometrical Accuracy Report of proposed machines (as per pt. no. 3 & 4).	Vendor to submit.
8	Vendor to confirm that all the dimensions, accuracies & surface finish of the component shall be met as per Technical Requirements & drawing.	Vendor to confirm.
9	Vendor to note that all tools, measuring equipments, technological items etc. required for manufacturing of subject item shall be arranged by vendor, in case of order.	Vendor to confirm.
10	BHEL reserves the right to verify the information provided by vendor. BHEL may also visit vendor works if so desired by BHEL. In case, the information provided by vendor is found to be false/ incorrect, their offer shall be rejected.	Vendor to note & Confirm.


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 Sr.Mgr./NCT

Scope of Work

I.P. Inner Casing of 800 MW Steam Turbine in rough machined condition with blade grooves machining, is proposed to be sub -contracted as per machining details & technical requirements furnished in drawing no. 01060230000 (sheet 1,2 & 3) & drawing no. 91020430052 (sheet 1 &2).

Scope of work for rough machining includes the followings: -

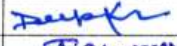
A) The casing raw material is alloy steel casting in two halves (Tensile Strength: 630-750 Mpa). The casing halves will be sent to vendor after control marking at BHEL Haridwar. Technological joint plane fasteners and taper pins shall be provided by the BHEL.

B) Scope of work for machining by vendor includes the following: -

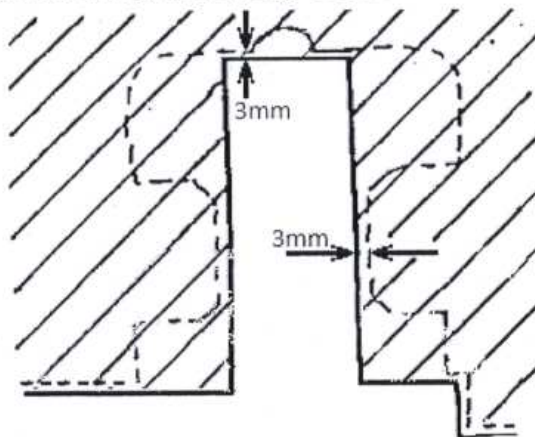
1. Joint Plane of casing halves will be machined with 0.5 mm finishing allowance, with original drawing accuracies.
2. Machining of joint plane holes, back counters & threaded holes as per Section E-E, Q-Q, F-F, (Sheet-2- I.P.I.C. Drg.) in both halves to be done, considering allowance on joint plane.
3. Guide Bolt holes (Section S-S) are only to be machined in Upper half casing and **not** to be machine in Lower Half casing.
4. For Pin holes (Section R-R), initially hole dia. 30 to be machined by vendor, in place of Pin dia. 40.
5. Final Machining of Taper pin holes to be done in assembled condition, as per Sec R-R. Two halves of the casings are to be assembled together with joint plane fasteners and taper pins. These joint plane fasteners and taper pins shall be provided by BHEL. Vertical boring operation to be carried out in assembled condition.

C) Following details/ dimensions of the drawing are **not** be machined by Vendor.

1. Refer I.P. Inner casing drawing no.01060230000: 4 holes of cylindrical pins as per section Y-Y (sheet-1) and details P1 & P2, sections P1-P1 & P2-P2 (sheet-2) are **not** to be machine in both the casing halves.
2. Refer Groove Plan Casing drawing no.91020430052: Sealing fin grooves as per Detail- Z3 (Sh-1) and Detail-Z4 (Sh-2) are **not** to be machine in both the casing halves.
3. Refer Groove Plan Casing drawing no.91020430052 Sheet-1:
 - i. Radius 350 mm & Radius 90 mm (drawing zone K-33) and chamfer 5x30 deg, chamfer 2x15 deg, chamfer 30deg, 40deg & radius 35 mm (drawing zone B-10) are **not** to be machine in both the casing halves.

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- ii. Pocket radius R16, R8, R8, R4 and 28 holes of diameter 116 mm are **not** be machine in both the casing halves (drawing zone E-26)
4. Refer Groove Plan Casing drawing no.91020430052 Sheet-2:
- i. Radius 35 mm chamfer 40 deg, chamfer 30deg, chamfer 5x30 deg & chamfer 2x15 deg (drawing zone C-28) and Radius 350 mm, Radius 65 mm (drawing zone K-5) are **not** to be machine in both the casing halves.
- ii. Pocket radius R4, R8, R8, R16 and 36 holes of diameter 60 mm are **not** be machine in both the casing halves (drawing zone D-18)
- D) All other details / dimensions are to be machined with 3 mm finishing allowance (at tool point) on all axial dimensions & radial dimensions, with original drawing accuracies. In Blade grooves the T portion shall be machined at BHEL. Only Neck width is to be rough machined. Refer "T-Groove Rough Machining" detail.



T- GROOVE ROUGH MACHINING

- E) Pockets at diameter 1598 mm of width 118 mm (Sheet-1, drawing zone E-26) and diameter 1463 mm of width 62 mm (Sheet-2, drawing zone D-18) are to be machined with 3 mm finishing allowance (at tool point) on all axial dimensions & radial dimensions, with original drawing accuracies.
- F) All the axial dimensions in specified tolerances are to be maintained from reference plane.
- G) All other requirements of QP, Standards and T.R. on the drawing to followed.
- H) Special care to be exercised with respect to the following points and party to confirm adherence to the same point-wise while submitting the offer: -
- i. No flaws like blow holes, shrinkage, inclusions etc. should open up during machining. However, if any flaw opens up during machining, vendor shall immediately intimate detail and location of flaw and corrective action proposed. Further machining will be suspended till BHEL approves corrective action.

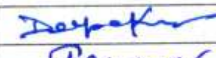
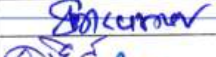
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NCT	R.P. Singh, Sr. Mgr.		01.05.2025
TUM	Arbind Choubey, Sr.Mgr.		01.05.2025
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- ii. BHEL shall furnish clarifications, if any, w.r.t. the scope of work or drg. dimensions / technical requirements to the party to enable it to submit technical / commercial offers.
- iii. Vendor must ensure that all requirements indicated in the drg. regarding:
 - o Surface finishes (Ra value indicated in microns)
 - o Sizes and tolerances
 - o Geometrical accuracies e.g. run-outs, concentricity, parallelity, perpendicularity etc. shall be fully met.

Reference surfaces are clearly marked in the concerned drawings.
- iv. After machining, inspection report is to be submitted to BHEL for final clearance.
- v. Inspection of the job at supplier's works shall be carried out as per BHEL approved quality plan by BHEL/ agency authorized by BHEL for which adequate prior notice (min. 4weeks) shall be given by the supplier.
- vi. To carry out vertical boring operation, two halves of the casing are to be assembled together with technological joint plane fasteners & taper pins.
- vii. All technical requirements listed in drawings shall be fully met.
- viii. Identification marking is to be done as per Technical Requirement no. 9 of the drawing 01060230000.
- ix. Broad process plan for the machining of IP Inner casing is given in Annexure-I, for reference.
- x. All cross-referred documents given in Annexure-II.

I) Packing and Preservation instructions:

- i. Conserve components as per BHEL's conservation instructions (**Table-1 of ST 33004**) suitable for 6 months. **PAINT IS NOT ALLOWED on any surface.** If as per ST33004 the outer unmachined surface of any component is specified to be painted, this requirement should be disregarded. Instead, the unmachined surface should be conserved in the same manner as the machined surface, following the conservation requirements outlined in ST33004.
- ii. Cover joint plane with plywood + rubber sandwiching (e.g., 10 mm rubber + 20 mm plywood) using suitable bracket and other critical machined surfaces with plastic/rubberized caps/wooden protectors to prevent mechanical damage.
- iii. Wrap with a minimum 90 GSM polythene sheet, and enclose them with industrial-grade shrink wrap.
- iv. Place components on strong suitable wooden skids or metal base frames with sufficient load-bearing capacity.
- v. Ensure that all lifting lugs and bollards are clearly marked and easily accessible, as lifting and handling of the component together with its skid shall be carried out using the bollards provided on the component.

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**Technical Delivery Condition for Sub-contracting for
Rough Vertical & Horizontal Machining of IP Inner
Casing for 800 MW ST**

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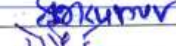
- vi. Use shock-absorbing materials (e.g., rubber pads) between the component and the skid/base to avoid impact damage during transport.
- vii. Lock components with appropriate metallic strap/ slings or belts with skid after wrapping and placement on skids/base frames.
- viii. Ensure packaging is durable enough to withstand the weight of the components and Packing of the finish machined component should be suitable to protect damage to machined surfaces during handling and transportation.

J) Labelling & Marking:

- i. Each half of the casing shall be clearly labelled with the following:
 - o Component Name
 - o Drawing Number
 - o BHEL PO Number
 - o Handling Instructions (pictogram or written)
 - o "Do Not Lift from Machined Surface" warning
- ii. Ensure tags and labels are waterproof, non-removable, and securely attached.
- iii. Enclose a waterproof envelope containing the packing list and attach it externally.
- iv. Take photographic evidence of the packaging and protection before dispatch and submit it to BHEL.

ANNEXURE-I**1. Horizontal Boring:**

- a) Rough machining of joint plane of upper half, machining of joint plane holes and machining of alignment points.
 - b) Rough machining of joint plane of lower half and machining of alignment points.
 - c) Transfer marking of joint plane holes from upper half to lower half.
 - d) Drill & tapping of joint plane holes in lower half.
2. Assembly of upper & lower half of the casing.
3. Drilling & reaming of taper pin holes in assembled condition of the casing. Fit taper pins into the holes.
4. **Vertical Boring:** Rough vertical boring of assembled casing as per drawing.

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TUM	Arbind Choubey, Sr.Mgr.		01.05.2025
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ANNEXURE-II

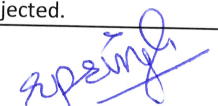
List of drawings / standards to be referred

1. IP Inner Casing (Finish machined drawing)01060230000
2. Groove Plan IPT.....91020430052
3. Blade groove.....31010730011
4. Blade groove.....31010730012
5. Blade groove.....31020430012
6. Blade groove.....31020430013
7. Identification of work pieces.....HW0400397
8. Log Sheet.....01060230000 LS
9. Log Sheet.....91020430052 LS
- 10.BHEL Standard noST01006 & ST01013

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Pre-Qualifying Requirement (PQR)		TTX/PQR/2025/150
For complete machining of IP Inner Casing (Drg. no. - 01060230000)		
SL. No.	REQUIREMENT	REMARKS
1	Only those vendors should quote who have following machine, facilities installed & operational at their works for following operations for machining & fitting works of "IP Inner Casing". Applicable details are as follows : (i) For Finish Machining, drawing number- 01060230000 (Sheet 1,2 & 3) and for Groove Plan machining, drawing number- 91020430052 (Sheet 1 & 2) shall be applicable. (ii) Raw material casting halves (as per drawing no.01060230901) shall be supplied to vendor after control marking for complete machining before blading work. Vendor to carry out machining as per Technical Delivery Condition (TDC) and Drg. provided. Vendor to provide point wise acceptance of TDC terms with their offer.	Vendor to confirm & provide point wise acceptance of TDC each terms.
2	Vendor must have suitable toolings / facility such as Marking Table / Machine Bed etc. in good working condition, to facilitate marking / transfer marking of job (as required). Vendor must have suitable facility for lifting / handling the subject job.	Vendor to confirm.
3	Horizontal Boring work :-	(a) Vendor to confirm. (b) Vendor to provide machine details / specification for referred operation.
3.1	Vendor must have CNC Horizontal Boring machine , suitable for machining of Joint Plans, holes, Threaded holes, details & Slots of IP Inner Casing as per drawing & T.R.'s requirement. Machine Requirement : (a)X traverse : 3500 mm or more (b)Y traverse : 4000 mm or more (c)Ram + Spindle movement in Z direction : 2000 mm or more (d)Rotary Table: 3500 mm x 3500 mm or more, Weight capacity : 82 Tons or more. (e)Machine should have right angle head facility for drilling & milling. (f) CNC programable boring and facing heads UT1000 or equivalent.	
4	Turning / Vertical Boring Operation :-	
4.1	Vendor must have CNC Vertical Boring Machine , suitable for complete Vertical Boring of IP Inner Casing as per drawing & T.R.'s requirement. Machine Requirement : (a) Table diameter of machine = 4000 mm or more. (b) Maximum Turning Height of job = 4000 mm or more. (c) Ram Stroke =2000 mm or more (d) Maximum weight capacity of machine = 82 Tons or more.	(a) Vendor to confirm. (b) Vendor to provide machine details / specification for referred operation.
5	Fitting work :-	
5.1	Vendor must have suitable facility / arrangement for different fitting / assembly works / colour matching work to be done as per drawing & TR.	Vendor to confirm.
6	Vendor to confirm that above machines (as per pt. no. 3 & 4) are available at their works & are in good working condition with capability of achieving accuracies, surface finish & tolerances as per drawing requirements. If necessary, Vendor can suggest alternate machines (other than specified in pt. no. 3 & 4) for machining job with accuracies, surface finish & tolerances as per drawing, for review & acceptance by BHEL.	Vendor to confirm & submit the machine accuracies & Geometry details along with specification.
7	Vendor to submit Geometrical Accuracy Report of proposed machines (as per pt. no. 3 & 4).	Vendor to submit.
8	Vendor to confirm that all the dimensions, accuracies & surface finish of the component shall be met as per Technical Requirements & drawing.	Vendor to confirm.
9	Vendor to note that all tools, measuring equipments, technological items etc. required for manufacturing of subject item shall be arranged by vendor, in case of order.	Vendor to confirm.
10	BHEL reserves the right to verify the information provided by vendor. BHEL may also visit vendor works if so desired by BHEL. In case, the information provided by vendor is found to be false/ incorrect, their offer shall be rejected.	Vendor to note & Confirm.


Deepak Kumar
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Technical Delivery Conditions for Sub-contracting for Finish machining of IP Inner Casing of 800 MW ST

TTX/TDC/2025/143

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Scope of Work

I.P. Inner Casing of 800MW Steam Turbine in finish machined condition along with blade grooves machining, is proposed to be sub-contracted as per machining details & technical requirements furnished in drawing no. 01060230000 (sheet 1, 2, 3 & 4) & drawing no. 91020430052 (sheet 1 & 2).

Scope of work for finish machining of the casing includes the followings: -

- A) The casing raw material is alloy steel casting in two halves (Tensile Strength: 630-750 Mpa). The casing halves will be sent to vendor from BHEL Haridwar after control marking at BHEL. Technological joint plane fasteners and taper pins shall be provided by the BHEL.
- B) Machining of inner contour including blade grooves & sealing grooves shall be carried out as per 'Groove Plan Casing I.P. Turbine' drawing no. 9-10204-30052 (Sheet 1 & 2).
 - i. Machining of Inner contour including blade grooves and sealing grooves involves critical dimensions with close tolerances. Vendor to strictly meet all dimensions as per drawing requirements.
 - ii. Detail dimensions of each stage Blade groove are given in their respective Groove Drawings (as listed in Table.1). Vendor to meet all the dimensions, tolerances including surface finish, perpendicularity and cylindricity as per respective drawing requirements.
 - iii. The groove plan drawing provides details for the grooves to be machined in the I.P. Inner Casing. The drawing numbers for the blade grooves in the casing are listed below:

I.P. Inner casing			
Stage'L'	Drawing No.	Stage 'R'	Drawing No.
2L	31010730011	2R-7R	31020430012
3L-9L	31020430012	8R-12R	31010730011
10L	31020430013	13R-15R	31010730012
11L	31020430012		
12L-13L	31010730011		
14L-15L	31010730012		

All the axial dimensions in specified tolerances are to be maintained from reference plane.

- iv. **The Blade fitting, seal strip fitting and subsequent machining will be done by BHEL Haridwar, at BHEL works.**
- C) **The thermocouple hole** locations in the inner casing shall be in accordance with drawing no. **21062230000**. The casing wall thickness for drilling the thermocouple holes, as well as the drill depth, must be confirmed through ultrasonic testing before drilling the thermocouple holes.

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TUM	Arbind Choubey, Sr.Mgr.		13.08.2025
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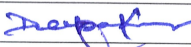
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**Technical Delivery Conditions for Sub-contracting for
Finish machining of IP Inner Casing of 800 MW ST**

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- D) Surface finish of joint plane should be Ra 1.6. Steam tightness of joint plane should be ensured by color matching. In assembled condition the gap at joint plane must not exceed following value:
From inside of the Casing $\leq 0.02\text{mm}$
From outside of the Casing $\leq 0.05\text{ mm}$
This must be checked by feeler gauge.
- E) All other requirements of QP, Standards and T.R. on the drawing to followed.
- F) Special care to be exercised with respect to the following points and party to confirm adherence to the same point-wise while submitting the offer: -
- No flaws like blow holes, shrinkage, inclusions etc. should open up during machining. However, if any flaw opens up during machining, vendor shall immediately intimate detail and location of flaw and corrective action proposed. Further machining will be suspended till BHEL approves corrective action.
 - BHEL shall furnish clarifications, if any, w.r.t. the scope of work or drg. dimensions / technical requirements to the party to enable it to submit technical / commercial offers.
 - Vendor must ensure that all requirements indicated in the drg. regarding:
 - Surface finishes (Ra value indicated in microns)
 - Sizes and tolerances
 - Geometrical accuracies e.g. run-outs, concentricity, parallelity, perpendicularity etc. shall be fully met.
- Reference surfaces are clearly marked in the concerned drawings.
- After finish machining, inspection report is to be submitted to BHEL for final clearance.
 - Inspection of the job at supplier's works shall be carried out as per BHEL approved quality plan by BHEL/ agency authorized by BHEL for which adequate prior notice (min. 4weeks) shall be given by the supplier.
 - To carry out vertical boring operation, two halves of the casing are to be assembled together with technological joint plane fasteners & taper pins.
 - All technical requirements listed in drawings shall be fully met.
 - A specific *certificate for steam tightness* of horizontal joint as called for in Technical Requirements no. 1 for Steam Tightness on drawing 01060230000, Sheet no. 1 is to be submitted along with the supply.
 - Identification marking is to be done as per Technical Requirement no. 9 of the drawing 01060230000.
 - Broad process plan for the machining of IP Inner casing is given in **Annexure-I**, for reference.
 - All cross-referred documents given in **Annexure-II**

TTX	Deepak Kumar, Dy. Mgr.		13.08.2025
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**Technical Delivery Conditions for Sub-contracting for
Finish machining of IP Inner Casing of 800 MW ST**

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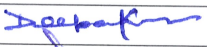
G) Packing and Preservation instructions:

- Conserve components as per BHEL's conservation instructions (**Table-1 of ST 33004**) suitable for 6 months. **PAINT IS NOT ALLOWED on any surface.** If as per ST33004 the outer unmachined surface of any component is specified to be painted, this requirement should be disregarded. Instead, the unmachined surface should be conserved in the same manner as the machined surface, following the conservation requirements outlined in ST33004.
- Cover joint plane, flanges with plywood + rubber sandwiching (e.g., 10 mm rubber + 20 mm plywood) using suitable bracket and other critical machined surfaces with plastic/rubberized caps/wooden protectors to prevent mechanical damage.
- Wrap with a minimum 90 GSM polythene sheet, and enclose them with industrial-grade shrink wrap.
- Place components on strong suitable wooden skids or metal base frames with sufficient load-bearing capacity.
- Ensure that all lifting lugs and bollards are clearly marked and easily accessible, as lifting and handling of the component together with its skid shall be carried out using the bollards provided on the component.
- Use shock-absorbing materials (e.g., rubber pads) between the component and the skid/base to avoid impact damage during transport.
- Lock components with appropriate metallic strap/ slings or belts with skid after wrapping and placement on skids/base frames.
- Ensure packaging is durable enough to withstand the weight of the components and Packing of the finish machined component should be suitable to protect damage to machined surfaces during handling and transportation.

H) Labelling & Marking:

- Each half of the casing shall be clearly labelled with the following:
 - Component Name
 - Drawing Number
 - BHEL PO Number
 - Handling Instructions (pictogram or written)
 - "Do Not Lift from Machined Surface" warning
- Ensure tags and labels are waterproof, non-removable, and securely attached.
- Enclose a waterproof envelope containing the packing list and attach it externally.

Take photographic evidence of the packaging and protection before dispatch and submit it to BHEL.

TTX	Deepak Kumar, Dy. Mgr.		13.08.2025
TUM-PIg	Manoj Kumar, Sr.Mgr.		13.08.2025
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TUM	Arbind Choubey, Sr.Mgr.		13.08.2025
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Technical Delivery Conditions for Sub-contracting for Finish machining of IP Inner Casing of 800 MW ST

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ANNEXURE-I

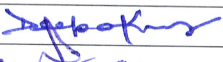
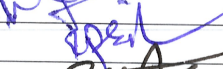
1. Horizontal Boring:

- a) Rough machining of joint plane of upper half of the casing including joint plane holes and machining of alignment points.
 - b) Rough machining of joint plane of lower half and machining of alignment points.
 - c) Transfer marking of joint plane holes from upper half to lower half.
 - d) Drill & tapping of joint plane holes in lower half.
2. Assembly of upper & lower half of the casing.
 3. Drilling & reaming of taper pin holes in assembled condition of the casing. Fit taper pins into the holes.
 4. **Vertical Boring:** Rough vertical boring of assembled casing as per drg.
 5. Dismantling of casing halves.
 6. **Horizontal Boring:** Finish machining of joint plane of upper & lower half.
 7. **Colour Matching:** Colour matching of joint plane of upper & lower half as per technical requirement-1 of the drg no 01060230000
 8. Assembly of upper & lower half of the casing.
 9. Re-reaming of taper pin holes & fit taper pin into the holes.
 10. **Vertical Boring:** Finish vertical boring of assembled casing as per drg.
 11. **Horizontal Boring:** Drilling & reaming of cylindrical pin holes in assembled condition of the casing.
 12. Dismantling of casing halves.
 13. **Horizontal Boring:**
 - a) Upper Half: details machining as per drg.
 - b) Lower Half: details machining as per drg.

ANNEXURE-II

List of drawings / standards to be referred

1. IP Inner Casing (Finish machined drawing)01060230000
2. Groove Plan IPT.....91020430052
3. Blade groove.....31010730011
4. Blade groove.....31010730012
5. Blade groove.....31020430012
6. Blade groove.....31020430013
7. Identification of work pieces.....HW0400397
8. Procedure for Color matching of Joint Plane.....HW0992017
9. BHEL Standard.....ST01007, ST01013
9. Log Sheet.....01060230000 LS
10. Log Sheet.....91020430052 LS

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TUM	Arbind Choubey, Sr.Mgr.		13.08.2025
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Pre-Qualifying Requirement (PQR)		
For complete machining of IP Outer Casing (660 MW)		TTX/PQR/2026/0236
SL. No.	REQUIREMENT	REMARKS
1	Only those vendors who have the following machines and facilities installed and operational at their works shall be eligible to quote for carrying out the machining and fitting operations on the "IP Outer Casing" of 660 MW Steam Turbine. The applicable requirements are as follows: (i) Sheets 1, 2, and 3 of the applicable finish drawing shall be considered for finish machining. (ii) Raw material casting halves (as per applicable drawings) shall be supplied to the vendor after control marking for complete machining. Vendor to carry out machining as per Technical Delivery Condition (TDC) and drawing provided. Vendor to provide point wise acceptance of TDC terms with their offer.	Vendor to confirm & provide point wise acceptance of TDC each terms.
2	Vendor must have suitable toolings / facility such as Marking Table / Machine Bed etc. in good working condition, to facilitate marking / transfer marking of job (as required). Vendor must have suitable facility for lifting / handling the subject job.	Vendor to confirm.
3 (A)	Joint Plane milling, joint plane hole drilling/boring/threading & Pipes details machining: - Vendor must have CNC Horizontal Boring machine , suitable for machining of Joint Plane holes, counter bores, threaded holes, pockets, keyway & other details of IP Outer Casing as per drawing & technical requirements. Machine Requirement : (a) X traverse : 6000 mm or more (b) Y traverse : 5000 mm or more (c) Ram + Spindle movement in Z direction : 2000 mm or more (d) Rotary Table: 4000mm x 4000 mm, Weight capacity : 45 ton (e) Machine should have right angle head facility for drilling & milling.	(a) Vendor to confirm. (b) Vendor to provide machine details / specification for referred operation.
3 (B)	Turning of Both side of Shaft Seal Bores in assembled condition as per Detail C1 & C2: CNC Vertical Boring Machine : Machine Requirement : (i) (a) Table diameter of machine = 6500 mm or more. (b) Maximum Turning Height of job = 6000 mm or more. (c) Ram Stroke = 3000 mm or more OR CNC Gantry Milling Machine : Machine Requirement : (ii) (a) Distance between column : 5000 mm or more (b) Gantry Table to crossrail height : 5000mm or more (c) Machine Bed should be suitable to accommodate the job in assembled conditioned having weight capacity 90 Tons or more. (d) Machine should have right angle Boring & facing head facility suitable for machining bore depth and dia as per drawing. OR CNC Horizontal Boring Machine : Machine Requirement : (iii) (a) Rotary Table : 4000mm X 4000mm or more (b) RAM+Spindle traverse : 2000 mm or more (c) Milling height : 2500 mm or more (d) Machine Table should be suitable to accommodate the job in assembled conditioned having weight capacity 90 Tons or more. Vendor to submit details of machine table. (e) Machine should have Boring & facing head facility suitable for machining bore depth and dia as per drawing.	(a) Vendor to confirm. (b) Vendor to provide machine details / specification for referred operation. (c) Vendor to submit boring and facing head details (d) Manufacturing Process indicating steps to ensure shaft seal bore co-axiality, runouts etc to be provided.
4	Fitting work :-	
4.1	Vendor must have suitable facility / arrangement for different fitting / assembly works / colour matching work to be done as per drawing & technical requirements.	Vendor to confirm.
5	Vendor to confirm that above machines (as per pt. no. 3A & 3B) are available at their works & are in good working condition with capability of achieving accuracies, surface finish & tolerances as per drawing requirements.	Vendor to confirm
6	Vendor to submit Geometrical Accuracy Report of proposed machines (as per pt. no. 3A & 3B).	Vendor to submit.
7	Vendor to confirm that all the dimensions, accuracies & surface finish of the component shall be met as per Technical Requirements & drawing.	Vendor to confirm.
8	Vendor to note that all tools, measuring equipments, technological items etc. required for manufacturing of subject item shall be arranged by vendor, in case of order.	Vendor to confirm.
9	BHEL reserves the right to verify the information provided by vendor. BHEL may also visit vendor works if so desired by BHEL. In case, the information provided by vendor is found to be false/ incorrect, their offer shall be rejected.	Vendor to note & Confirm.

Deepak Kumar
Mgr./TTX

R P Singh
Sr.Mgr./NCT

Pre-Qualifying Requirement (PQR)

For complete machining of IP Outer Casing (Drg. no. - 01060130000)

TTX/PQR/2025/115

SL. No.	REQUIREMENT	REMARKS
1	Only those vendors should quote who have following machine, facilities installed & operational at their works for following operations for machining & fitting works of "IP Outer Casing". Applicable details are as follows : (i) For finish machining, drawing number- 01060130000 (Sheet 1,2,& 3) shall be applicable. (ii) Raw material casting halves (drawing no.01060130901) shall be supplied to vendor after control marking for complete machining. Vendor to carry out machining as per Technical Delivery Condition (TDC) and drawing provided. Vendor to provide point wise acceptance of TDC terms with their offer.	Vendor to confirm & provide point wise acceptance of TDC each terms.
2	Vendor must have suitable toolings / facility such as Marking Table / Machine Bed etc. in good working condition, to facilitate marking / transfer marking of job (as required). Vendor must have suitable facility for lifting / handling the subject job.	Vendor to confirm.
3 (A)	Joint Plane milling, joint plane hole drilling/boring/threading & Pipes details machining: -	
	Vendor must have CNC Horizontal Boring machine, suitable for machining of Joint Plane holes, counter bores, threaded holes, pockets, keyway & other details of IP Outer Casing as per drawing & technical requirements. Machine Requirement: (a)X traverse : 6000 mm or more (b)Y traverse: 5000 mm or more (c)Ram + Spindle movement in Z direction: 2000 mm or more (d)Rotary Table: 4000mm x 4000 mm, Weight capacity: 45 ton (e)Machine should have right angle head facility for drilling & milling.	(a) Vendor to confirm. (b) Vendor to provide machine details / specification for referred operation.
3 (B)	Turning of Both side of Shaft Seal Bores in assembled condition as per Detail S5 & S6):	
(i)	CNC Vertical Boring Machine: Machine Requirement: (a) Table diameter of machine = 6500 mm or more. (b) Maximum Turning Height of job =6000 mm or more. (c) Ram Stroke =3000 mm or more (d) Maximum weight capacity of machine = 90 Tons or more.	
OR		
(ii)	CNC Gantry Milling Machine: Machine Requirement : (a) Distance between column : 5000 mm or more (b) Gantry Table to crossrail height : 5000mm or more (c) Machine Bed should be suitable to accommodate the job in assembled conditioned having weight capacity 90 Tons or more. (d) Machine should have right angle Boring & facing head facility suitable for machining bore depth and dia as per drawing.	(a) Vendor to confirm. (b) Vendor to provide machine details / specification for referred operation. (c) Vendor to submit boring and facing head details (d) Manufacturing Process indicating steps to ensure shaft seal bore co-axiality, runouts etc to be provided.
OR		
(iii)	CNC Horizontal Boring Machine: Machine Requirement: (a) Rotary Table: 4000mm X 4000mm or more. (b)RAM+Spindle traverse: 2000 mm or more. (c) Milling height: 2500 mm or more. (d) Machine Table should be suitable to accommodate the job in assembled conditioned having weight capacity 90 Tons or more. Vendor to submit details of machine table. (e) Machine should have Boring & facing head facility suitable for machining bore depth and dia as per drawing.	
4	Fitting work :-	
4.1	Vendor must have suitable facility / arrangement for different fitting / assembly works / colour matching work to be done as per drawing & technical requirements.	Vendor to confirm.
5	Vendor to confirm that above machines (as per pt. no. 3 A & 3B) are available at their works & are in good working condition with capability of achieving accuracies, surface finish & tolerances as per drawing requirements. If necessary, Vendor can suggest alternate machines (other than specified in pt. no. 3 A & 3B) for machining of the job with accuracies, surface finish & tolerances as per drawing, for review & acceptance by BHEL.	Vendor to confirm
6	Vendor to submit Geometrical Accuracy Report of proposed machines (as per pt. no. 3A & 3B).	Vendor to submit.
7	Vendor to confirm that all the dimensions, accuracies & surface finish of the component shall be met as per Technical Requirements & drawing.	Vendor to confirm.
8	Vendor to note that all tools, measuring equipments, technological items etc. required for manufacturing of subject item shall be arranged by vendor, in case of order.	Vendor to confirm.
9	BHEL reserves the right to verify the information provided by vendor. BHEL may also visit vendor works if so desired by BHEL. In case, the information provided by vendor is found to be false/ incorrect, their offer shall be rejected.	Vendor to note & Confirm.

Deepak Kumar
Dy. Mgr./TTX

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**Technical Delivery Condition for Sub-contracting for
Finish machining of IP Outer Casing for 660 MW ST**

TTX/TDC/2026/013

Page 1 of 4

Scope of Work

I.P. Outer Casing of 660 MW Steam Turbine in finish machined condition is proposed to be sub-contracted as per machining details & technical requirements furnished in the applicable finish machine drawing number (sheet 1, 2 & 3). Scope of work for finish machining includes the followings: -

- A) The casing raw material is nodular iron castings in two halves (Tensile Strength: 350-400 Mpa). The casing halves will be sent to vendor from BHEL Haridwar after control marking at BHEL. Technological joint plane fasteners and taper pins shall be provided by the BHEL.
- B) All finish machining details including diameters, holes/threaded holes, spot face, shaft seal grooves, pockets, keyways etc. shall be carried out in both the casing halves as per the applicable finish machine drawings.

Note: All the diameters & axial dimensions in specified tolerances are to be maintained from reference plane.

- C) Surface finish of joint plane should be Ra 1.6. Steam tightness of joint plane should be ensured by color matching. In assembled condition the gap at joint plane must not exceed following value:

From inside of the Casing $\leq 0.02\text{mm}$

From outside of the Casing $\leq 0.05\text{ mm}$

This must be checked by feeler gauge.

- D) Hydraulic testing as per T.R. 1 & 5 of the applicable finish drawing shall be in BHEL scope and will be carried out at BHEL Haridwar after receipt of finish machined casing halves from vendor.

- E) All other requirements of QP, Standards and T.R. on the drawing to followed.

- F) Special care to be exercised with respect to the following points and party to confirm adherence to the same point-wise while submitting the offer: -

- No flaws like blow holes, shrinkage, inclusions etc. should open up during machining. However, if any flaw opens up during machining, vendor shall immediately intimate detail and location of flaw and corrective action proposed. Further machining will be suspended till BHEL approves corrective action.
- BHEL shall furnish clarifications, if any, w.r.t. the scope of work or drawing dimensions / technical requirements to the party to enable it to submit technical / commercial offers.
- Vendor must ensure that all requirements indicated in the drawing regarding:
 - Surface finishes (Ra value indicated in microns)
 - Sizes and tolerances
 - Geometrical accuracies e.g. run-outs, concentricity, parallelity, perpendicularity etc. shall be fully met.

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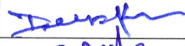
**Technical Delivery Condition for Sub-contracting for
Finish machining of IP Outer Casing for 660 MW ST**TTX/TDC/2026/013
Page 2 of 4

Reference surfaces are clearly marked in the concerned drawings.

- iv. After finish machining, inspection report is to be submitted to BHEL for final clearance.
- v. Inspection of the job at supplier's works shall be carried out as per BHEL approved quality plan by BHEL/ agency authorized by BHEL for which adequate prior notice (min. 4 weeks) shall be given by the supplier.
- vi. To carry out turning of both side of shaft seal bores of the casing, two halves of the casing are to be assembled together with technological joint plane fasteners & taper pins.
- vii. All technical requirements listed in the drawings shall be fully met.
- viii. Identification marking is to be done as per Technical Requirement no. 6 of the applicable finish drawing.
- ix. Broad process plan for the machining of IP Outer casing is given in Annexure-I, for reference.
- x. All cross-referred documents given in Annexure-II.

G) Packing and Preservation instructions:

- i. Conserve components as per BHEL's conservation instructions (**Table-1 of ST 33004**) suitable for 6 months. **PAINT IS NOT ALLOWED on any surface.** If as per ST33004 the outer unmachined surface of any component is specified to be painted, this requirement should be disregarded. Instead, the unmachined surface should be conserved in the same manner as the machined surface, following the conservation requirements outlined in ST33004.
- ii. Cover joint plane with plywood + rubber sandwiching (e.g., 10 mm rubber + 20 mm plywood) using suitable bracket and other critical machined surfaces with plastic/rubberized caps/wooden protectors to prevent mechanical damage.
- iii. Wrap with a minimum 90 GSM polythene sheet, and enclose them with industrial-grade shrink wrap.
- iv. Place components on strong suitable wooden skids or metal base frames with sufficient load-bearing capacity.
- v. Ensure that all lifting lugs and bollards are clearly marked and easily accessible, as lifting and handling of the component together with its skid shall be carried out using the bollards provided on the component.
- vi. Use shock-absorbing materials (e.g., rubber pads) between the component and the skid/base to avoid impact damage during transport.
- vii. Lock components with appropriate metallic strap/ slings or belts with skid after wrapping and placement on skids/base frames.
- viii. Ensure packaging is durable enough to withstand the weight of the components and Packing of the finish machined component should be suitable to protect damage to machined surfaces during handling and transportation.

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**Technical Delivery Condition for Sub-contracting for
Finish machining of IP Outer Casing for 660 MW ST**TTX/TDC/2026/013
Page 3 of 4**H) Labelling & Marking:**

- i. Each half of the casing shall be clearly labelled with the following:
 - o Component Name
 - o Drawing Number
 - o BHEL PO Number
 - o Handling Instructions (pictogram or written)
 - o "Do Not Lift from Machined Surface" warning
- ii. Ensure tags and labels are waterproof, non-removable, and securely attached.
- iii. Enclose a waterproof envelope containing the packing list and attach it externally.
- iv. Take photographic evidence of the packaging and protection before dispatch and submit it to BHEL.

ANNEXURE-I**1. Horizontal Boring:**

- a) Rough machining of joint plane of upper half, machining of joint plane holes and machining of alignment points.
- b) Rough machining of joint plane of lower half and machining of alignment points.
- c) Transfer marking of joint plane holes from upper half to lower half.
- d) Drill & tapping of joint plane holes in lower half.
- e) Finish machining of joint plane of upper half & lower half.

2. Colour Matching: Colour matching of joint plane of upper & lower half as per technical requirement-3 of the applicable finish drawing.

3. Assembly of upper & lower half of the casing.

4. Drilling & reaming of taper pin holes in assembled condition of the casing. Fit taper pins into the holes.

5. Turning of Shaft Seal Bores: Finish turning of both side of shaft seal bores in assembled conditioned as per detail C1 & C2 of the applicable finish machine drawing.

6. Dismantling of casing halves.

7. Horizontal Boring:

- a) Upper Half: details machining as per drawing.
- b) Lower Half: details machining as per drawing.

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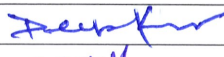
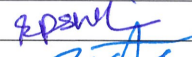
**Technical Delivery Condition for Sub-contracting for
Finish machining of IP Outer Casing for 660 MW ST**

TTX/TDC/2026/013
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ANNEXURE-II

List of drawings / standards to be referred

1. IP Outer Casing (Finish machined drawing) ... Sh-1, 2 & 3.
2. Identification of work pieces.....HW0400397
3. Procedure for Color matching of Joint Plane.....HW0992017
4. Machining of Alignment points in ST casing.....HW0690199
5. Product Standards for threaded holes.....ST01007
6. Log Sheets.....as applicable.

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**Technical Delivery Condition for Sub-contracting for
Finish machining of IP Outer Casing for 800 MW ST**TTX/TDC/2025/120
Page 1 of 4**Scope of Work**

I.P. Outer Casing of 800MW Steam Turbine in finish machined condition is proposed to be procured as per machining details & technical requirements furnished in drg.no. 01060130000 (sheet 1, 2 & 3). Scope of work for finish machining includes the followings: -

- A) The casing raw material is nodular iron castings in two halves (Tensile Strength: 350-400 Mpa). The casing halves will be sent to vendor from BHEL Haridwar after control marking at BHEL. Technological joint plane fasteners and taper pins shall be provided by the BHEL.
- B) All finish machining details including diameters, holes/threaded holes, spot face, shaft seal grooves, pockets, keyways etc. shall be carried out in both the casing halves as per drawing no. 01060130000.

Note: All the diameters & axial dimensions in specified tolerances are to be maintained from reference plane.

- C) Surface finish of joint plane should be Ra 1.6. Steam tightness of joint plane should be ensured by color matching. In assembled condition the gap at joint plane must not exceed following value:

From inside of the Casing $\leq 0.02\text{mm}$

From outside of the Casing $\leq 0.05\text{ mm}$

This must be checked by feeler gauge.

- D) Hydraulic testing as per T.R. 1 & 5 of the drawing shall be in BHEL scope and will be carried out at BHEL Haridwar after receipt of finish machined casing halves from vendor.
- E) All other requirements of QP, Standards and T.R. on the drawing to followed.
- F) Special care to be exercised with respect to the following points and party to confirm adherence to the same point-wise while submitting the offer: -
- No flaws like blow holes, shrinkage, inclusions etc. should open up during machining. However, if any flaw opens up during machining, vendor shall immediately intimate detail and location of flaw and corrective action proposed. Further machining will be suspended till BHEL approves corrective action.
 - BHEL shall furnish clarifications, if any, w.r.t. the scope of work or drawing dimensions / technical requirements to the party to enable it to submit technical / commercial offers.
 - Vendor must ensure that all requirements indicated in the drawing regarding:
 - Surface finishes (Ra value indicated in microns)
 - Sizes and tolerances
 - Geometrical accuracies e.g. run-outs, concentricity, parallelity, perpendicularity etc. shall be fully met.Reference surfaces are clearly marked in the concerned drawings.
 - After finish machining, inspection report is to be submitted to BHEL for final clearance.

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TUM	Arbind Choubey, Sr.Mgr.		21.06.2025
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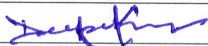
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**Technical Delivery Condition for Sub-contracting for
Finish machining of IP Outer Casing for 800 MW ST**TTX/TDC/2025/120
Page 2 of 4

- v. Inspection of the job at supplier's works shall be carried out as per BHEL approved quality plan by BHEL/ agency authorized by BHEL for which adequate prior notice (min. 4 weeks) shall be given by the supplier.
- vi. To carry out turning of both side of shaft seal bores, two halves of the casing are to be assembled together with technological joint plane fasteners & taper pins.
- vii. All technical requirements listed in the drawings shall be fully met.
- viii. Identification marking is to be done as per Technical Requirement no. 7 of the drawing 01060130000.
- ix. Broad process plan for the machining of IP Outer casing for reference is given in Annexure-I.
- x. All cross-referred documents given in Annexure-II

G) Packing and Preservation instructions:

- i. Conserve components as per BHEL's conservation instructions (**Table-1 of ST 33004**) suitable for 6 months. **PAINT IS NOT ALLOWED on any surface.** If as per ST33004 the outer unmachined surface of any component is specified to be painted, this requirement should be disregarded. Instead, the unmachined surface should be conserved in the same manner as the machined surface, following the conservation requirements outlined in ST33004.
- ii. Cover joint plane with plywood + rubber sandwiching (e.g., 10 mm rubber + 20 mm plywood) using suitable bracket and other critical machined surfaces with plastic/rubberized caps/wooden protectors to prevent mechanical damage.
- iii. Wrap with a minimum 90 GSM polythene sheet, and enclose them with industrial-grade shrink wrap.
- iv. Place components on strong suitable wooden skids or metal base frames with sufficient load-bearing capacity.
- v. Ensure that all lifting lugs and bollards are clearly marked and easily accessible, as lifting and handling of the component together with its skid shall be carried out using the bollards provided on the component.
- vi. Use shock-absorbing materials (e.g., rubber pads) between the component and the skid/base to avoid impact damage during transport.
- vii. Lock components with appropriate metallic strap/ slings or belts with skid after wrapping and placement on skids/base frames.
- viii. Ensure packaging is durable enough to withstand the weight of the components and Packing of the finish machined component should be suitable to protect damage to machined surfaces during handling and transportation.

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**Technical Delivery Condition for Sub-contracting for
Finish machining of IP Outer Casing for 800 MW ST**TTX/TDC/2025/120
Page 3 of 4**H) Labelling & Marking:**

- i. Each half of the casing shall be clearly labelled with the following:
 - o Component Name
 - o Drawing Number
 - o BHEL PO Number
 - o Handling Instructions (pictogram or written)
 - o "Do Not Lift from Machined Surface" warning
- ii. Ensure tags and labels are waterproof, non-removable, and securely attached.
- iii. Enclose a waterproof envelope containing the packing list and attach it externally.
- iv. Take photographic evidence of the packaging and protection before dispatch and submit it to BHEL.

ANNEXURE-I**1. Horizontal Boring:**

- a) Rough machining of joint plane of upper half, machining of joint plane holes and machining of alignment points.
- b) Rough machining of joint plane of lower half and machining of alignment points.
- c) Transfer marking of joint plane holes from upper half to lower half.
- d) Drill & tapping of joint plane holes in lower half.
- e) Finish machining of joint plane of upper half & lower half.

2. **Colour Matching:** Colour matching of joint plane of upper & lower half as per technical requirement-3 of the drawing no 01060130000.

3. Assembly of upper & lower half of the casing.

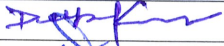
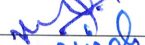
4. Drilling & reaming of taper pin holes in assembled condition of the casing. Fit taper pins into the holes.

5. **Turning of Shaft Seal Bores:** Finish turning of both side of shaft seal bores in assembled conditioned as per detail S5 & S6 of the drawing.

6. Dismantling of casing halves.

7. Horizontal Boring:

- a) Upper Half: details machining as per drawing.
- b) Lower Half: details machining as per drawing.

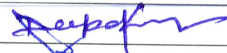
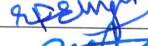
TTX	Deepak Kumar, Dy. Mgr.		21.06.2025
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HARIDWAR

**Technical Delivery Condition for Sub-contracting for
Finish machining of IP Outer Casing for 800 MW ST**TTX/TDC/2025/120
Page 4 of 4**ANNEXURE-II****List of drawings / standards to be referred**

1. IP Outer Casing (Finish machined drawing) ...01060130000 (Sh-1,2 & 3)
2. Identification of work pieces.....HW0400397
3. Procedure for Color matching of Joint Plane.....HW0992017
4. Machining of Alignment points in ST casing.....HW0690199
5. Product Standards for threaded holes.....ST01007
6. Log Sheet.....01060130000LS

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DEPTT.	NAME	SIGNATURE	DATE