TENDER CHANGE NOTE 01 (TCN – 01) DT:12-07-2007

WITH REFERENCE TO THE NIT, PUBLISHED IN THE WEB SITES FOR FOR MATERIALS MANAGEMENT, ERECTION, TESTING AND COMMISSIONING OF TURBINE, GENERATOR & AUXILIARIES FOR TISCO PH-6-1X120 MW STG PACKAGE AT TISCO, JAMSHEDPUR, FOLLOWING CHANGES MAY PLEASE BE NOTED AND COMPLIED WHILE SUBMITTING THE OFFER FOR THE SUBJECT JOB.

REF: TENDER DOCUMENT NO-PSER:SCT:JSD-TM764:07

01. Clarification on P-91 welding procedure (12 pages)- (FILE 2)
02. Revised Billing Schedule for TG (Rev-01)- (FILE-3)

BIDDERS TO NOTE THAT TCN-01 WILL FORM PART OF TECHNICAL SPECIFICATION & SPECIAL CONDITION OF CONTRACT OF TENDER DOCUMENT.

ALL OTHER TERMS & CONDITIONS OF THE TENDER REMAIN NCHANGED.

BIDDERS ARE REQUESTED TO SUBMIT OFFER BY DUE DATE.

DGM (SCT)

1. Referring to Annexure-I,the following procedures and arrangements required for welding of the P-91 piping materials may be noted for compliance :

Prior to erection, supplied pipes shall be inspected thoroughly and if any defect like crack, lamination, deposit noticed, the same shall be confirmed by Liquid Penetrant Inspection. If confirmed, same shall be referred to supply unit of BHEL for required repair.

1a EDGE PREPARATION AND FIT UP.

I. Cutting of P-91 material shall be done by hand saw / hack saw / machining / plasma cutting / grinding only.

II. Edge preparation shall be done only by machining and the required edge preparation machine shall be arranged by contractor at his cost. In extreme cases, edge can be prepared by grinding with prior approval of BHEL. During edge preparation care should be taken to avoid excessive pressure to prevent heating up of the pipe edges.

III. All edge preparation done at site shall be subjected to Liquid Penetration Test. Weld built-up on edge preparation is prohibited.

IV. The weld fit-up shall be carried out properly to ensure proper alignment and root gap. Neither tack welds nor bridge piece shall be used to secure alignment.

V. Partial root weld of minimum 20mm length by GTAW and fit-up by a clamping arrangement is recommended. Use of site manufactured clamps for fit-up is acceptable. The necessary pre-heat and purging shall be done. The fit-up shall be as per drawing. Root gap shall be 2 to 4 mm. Root mismatch shall be within 1 mm. Suitable reference punch marks shall be made on both the pipes (at 200 mm from the EP) at least on four axis to facilitate U. T on weld joint.

1b FIXING OF THETMOCOUPLES AND HEATING ELEMENTS DURING PRE-HEATING AND POST WELD HEAT TREATMENT.

No pre-heating is required for fixing T/C with resistance spot welding. Following are the equipment / facilities for heating cycles.

1.	Heating Method	:	Induction Heating
2.	Thermo couples	:	Ni-Cr / Ni – Al of 0.5 mm gauge size.
3.	Temp. Recorder	:	6 Points / 12 Points.

1c ARRANGEMENT FOR PURGING :

I. Argon gas with requisite quality shall be used for purging the root side of weld. The purging dam (blank) shall be fixed on either side of the weld bevel prior to Pre-heating. The dam shall be fixed inside the pipe

and it shall be located away from the heating zone. Purging is to be done for root welding (GTAW) followed by two filler passes of SMAW in case of butt welds. Purging is not required in case of nozzle and attachment welds, when they are not full penetration joints. The Argon gas to be used shall be dry. The flow rate is to be maintained during purging is 10 to 25 litres / minute and for shielding during GTAW is 8 to 14 ltres / minute.

II. Start purging from inside of pipe when root temperature reaches 220 deg. Centigrade. Provide continuous and adequate Argon gas to ensure complete purging in the root area. The minimum pre-flushing time for purging before start of welding shall be 5 minutes, irrespective of the pipe size. Wherever possible, solid purging gas chambers are to be used which can be removed after welding. If not possible, only water soluble paper is to be used. Plastic foils that are water soluble are not acceptable.

1d WELDERS QUALIFICATION

Only qualified welding procedures are to be used. Welders qualified as per ASME Section – IX and IBR on P-91 material shall only be engaged. Welders logbook to be maintained and welders performance shall be monitored by BHEL site welding engineer / Quality assurance engineer.

1e PREHEATING

Prior to start of pre-heating ensure that surfaces are clean and free from grease , oil and dirt. Pre-heating temperature shall be maintained at 220 deg. Centigrade by using induction heating. The temperature shall be ensured by using a calibrated autographic recorder and two calibrated thermocouples fixed at 0 and 180 degree positions on both pipes 50 mm away from the edge. The thermocouples shall be welded with spot welding machine. The pre-heating arrangement shall be inspected and approved by BHEL engineer.

Alternate arrangements shall be made during power failure. Two additional square thermocouple are to be fixed for emergency use. Gas burners shall employed to maintain the temperature until the power resumes.

1f WELDING

Root welding shall be done using GTAW process (as per WPS) five minutes after the start of Argon purging. Filler wires shall be clean and free from rust or oil. Argon purging shall be continued minimum two filler passes of SMAW. Argon gas to be used both for purging as well as shielding shall be of 99.99 purity level conforming to IS 5760-1998.

1g STORAGE OF WELDING CONSUMABLES :

I. Welding consumables are received with proper packing and marking which includes the relevant batch number for easy identification.

II. Electrodes are stored in their original sealed containers / packages until issued and kept in dry and clean environment taking care of shelf life.

III. Welding filler wires are received with proper packing and marking which includes the relevant batch number for easy identification.

IV. The filler wires are stored in original packages until issued and kept in dry and clean environment.

V. The electrode GTW wires issued to the welders should be controlled through issue slips. SMAW electrodes used must be dried in drying ovens with calibrated temperature controller. The drying temperature shall be as recommended by the electrodes manufacturer. The drying temp. shall be 200 – 300 deg. Centrigrades for two hours if it is not specified by manufacturer. Portable flasks shall be used by the welders for carrying electrodes and shall be kept at 100 deg. Centrigrades. Welding shall be carried out with short arc and stringer bead technology.

VI. The inter-pass temperature shall not exceed 350 deg. Centigrades. After completion of welding bring down the temperature to 80 – 100 deg. C and hold it at this temperature for one hour minimum. The PWHT shall commence after completion of one hour of soaking.

1h POST WELD HEAT TREATMENT :

I. A minimum of four thermocouples shall be placed such that at least two are on the weld and the other two on the base material on either side of the weld within the heating band at 180 deg C apart about 50 mm from the weld joint. One stand by thermocouple shall also be provided on the weld in case of any failure of the thermocouple. The width of the heated circumferential band on either side of the weld must be al least 5 times the thickness of the weld. In case of fillet joints the heating band shall be six times the thickness of the base material. An insulation of about 10mm thickness shall be provided between the cables and the weld joints.

II. Obtain the clearance for post weld heat treatment cycle from BHEL QAE / welding engineer. The PWHT temp. for P-91 with P-91 material shall be 760 + 10 Deg. C and the soaking time shall be 2.5 minutes per mm of weld thickness, subject to a MINIMUM OF TWO HOURS. All records shall be reviewed by BHEL welding engineer prior to PWHT clearance. Heating shall be done by Induction heating only. The rate of Heating / Cooling :

Thickness up to 50 mm	110	deg. Centrigrades
Thickness up to 50 – 75 mm	75	deg. Centrigrades / hr. (max)

Thickness more than 75 mm	55	deg. Centrigrades / hr. (max)

III. The width of the insulation beyond the heating band shall be at least two times the heating band width on either side of the weldment.

IV. The recording of time and temperature shall be continuously monitored with a calibrated recorder right from pre-heating. This shall be ensured at every one hour by a site authorized personnel.

1i PREVENTIVE MEASURES DURING POWER FAILURE AND NON-FUNCTIONING OF EQUIPMENT :

No interruption is allowed during welding and PWHT. Hence all equipment for the purpose of welding, heating etc. shall have alternative arrangements, (heating equipment, reserve thermocouple connections, gas burner arrangement for maintaining temperature etc.). Following preventive measures shall be adopted until normal power supply or backup power supply through diesel generator is restored.

(a) During start of pre-heating :

Weld fit-up arrangement shall be immediately covered with insulation along with complete circumference of the pipe and maintained at the temperature 80 to 100 deg. C until the power resumes. The temperature shall not be allowed to fall below 80 deg. C. Gas burners shall be employed to maintain the temperature till the power resumes. Preheating may be continued after power is resumed / alternate arrangement is made.

1. During GTAW / SMAW

Use gas burner arrangement to maintain the temperature at 80 to 100 Deg C up to a length of 50 mm on either side from weld center line along the complete circumference of the pipe. Root welding shall be continued after power is restored and preheating temperature is raised to 220 deg. C. During the above period temperature shall be recoded through contact type theromometer.

(c) During cooling cycle after SMAW welding to the holding temperature at 80 to 100 deg. C for one hour.

(d) During post weld heat treatment the following shall be followed
During heating cycle ---- The whole operation to be repeated from the beginning.

During soaking cycle ---- Heat treat (soak) subsequently for the entire duration.

During cooling (above 335 deg. C) --- Reheat to soaking temperature and cool at the required rate.

In all the cases mentioned above the temperature measurement on the weld joint by means of contact type calibrated temp. gauges shall be employed to record the temperature at regular interval of 15 minutes.

1j TEMPERATURE MONITORING

The welding and heat treatment chart shall be recorded for the following details. The actual PWHT chart shall be monitored for the following :

a) Pre-Heating
b) Interpass Temperature (GTAW + SMAW)
c) Cooling and holding at 80-100 deg. C for minimum one hour. Start PWHT after minimum one hour of soaking.
d) Heating to PWHT.

1k CAUTION

The PWHT temperature shall not deviate from the values specified in the chart range since any deviations to the specified holding temperature range, will adversely affect the mechanical properties of the weldment and may lead to rejection of the weldment. The weld joints should be kept dry. Under no circumstances any water / liquid is allowed to come in contact with weld as well as pre-heated portion of the pipe.

1l CALIBRATION

All equipment like recorder, thermocouple, compensating cable, oven, thermostat etc. should have valid calibration carried at BHEL approved labs. The calibrated reports should be reviewed and accepted by calibration In-charge at site prior to use.

1m NON DESTRUCTIVE EXAMINATION

I. Non destructive examination shall be done after PWHT. Prior to testing all welds shall be smoothly ground.

II. All welds (Butt and Fillet) shall be subjected to MPI. In addition to MPI, butt-welds and all full penetration welds shall be examined by UT.

III. LPI penetrant material (Dye penetrant, Solvent cleaner & developer) and medium (dry / wet particles) used in MPI shall be of BHEL approved brands only.

IV. For Ultrasonic Testing calibration blocks used shall be of the same material specification, dia and thickness.

V. The UT equipment shall be calibrated prior to use and should be of digital type -- Krautkramer model USN 50 or equivalent , capable of storing calibration data as well as ultrasonic results.

VI. All recordable indications will be stored in memory of digital flaw detector and PC for review at a later period.

VII. The equipment calibration data for specific weld as well as the hard copy of 'Static echo-trace pattern' - showing the flow echo amplitude with respect to DAC, flaw depth, projection surface, distance and beam – path shall be attached to UT test report. This hard copy of echo-trace with equipment calibration data will form part of test documentation.

VIII. The examination as well as evaluation shall be performed by a qualified Level – II personnel and a test report shall be submitted. Any defect noticed during NDE shall be marked with a marker.

1n REPAIR OF WELD JOINTS

(a) WELD REPAIR AT ROOT

On visual examination during root welding if it reveals any surface defects, the same shall be removed by grinding maintaining temperature 80 – 100 deg. C and rewelded with GTAW maintaining 220 deg. C before starting SMAW.

(b) WELD REPAIR ON COMPLETION

Any defect observed on the weld shall be brought to the notice of Quality Assurance Engineer. The size and nature of the defect shall be reviewed. Any repair on weld to be carried out on their approval. If some defects are noticed on fully completed joint while performing UT after completion of PWHT, the same may be assessed in order to find the seriousness of the defect and to locate where exactly the defect lies from the weld outside the surface. The defect area shall be marked and repaired as below:

1) The weld shall be removed by grinding (gouging not permitted) such that the area for repair welding is free from sharp corners and provided with sufficient slope towards the weld face sides. Incase of cut and weld joints HAZ will have to be removed by grinding.

2) Surface examination (MPI/ LPI) on the ground weld area to be performed to ensure a sound base material before depositing weld layers using SMAW.

3) The temperature of the weld is to be maintained at pre-heat temperature.

4) Carry out SMAW using the same procedure as that of welding.

5) All the specified precautions with respect to welding consumables, heating cycles, post weld heat treatment etc. as followed for original welding shall be strictly adhered.

6) The NDE shall be conducted for the entire weld joint.

7) If any further defects are observed on the repaired weld, the same may be further reworked as mentioned above.

1o HARDNESS SURVEY

The equipment recommended to measure the hardness are EQUOTIP or MICRODUR make or equivalent portable equipment, which is to be arranged by the bidder at their cost. The equipment used for the hardness measurement shall be calibrated as recommended by the manufacturer and also on a P-91 calibration block provided by BHEL. The surface shall be cleaned and prepared as per hardness test instrument manufacturer's recommendation prior to hardness survey. Hardness survey shall be done at each joint at three locations along the circumference. At each location three ratings on weld and parent material shall be carried out. All the hardness values shall be recorded. The maximum allowable hardness at weld and parent metal shall be 300 HV10. Joints having hardness above 300 HV shall be re-heat treated and hardness shall be checked again. If hardness is still more, refer the case to Unit.

1p COMBINATION WELDING

For the combination of material like P-22 with P-91 and X-22 with P-91 the WPS as approved by WTC shall be given by PC for adoption.

Material	Temperature	Soaking Time
P-91 + P-22	745 $\pm$ 15 deg. C	2.5 Minutes / mm minimum 1 Hr.)
P-91 + X-22	750 $\pm$ 10 deg. C	2.5 Minutes / mm Minimum 2 hour for thickness up to 50 mm and 4 hrs. for thickness more than 50 mm.

Precautions as required for P-91 shall be fully taken care of.

1q SPECIFIC TRAINING FOR WELDERS

I. The qualified welders who will be engaged in P-91 welding shall be given training on pipe joints simulated with P-91 welding and heating cycle conditions.

II. The acquaintance on welding positions, as applicable shall be given using P-91 pipes and P-91 welding consumables, Welding techniques and instructions on Dos and DON'T's of P-91 welding. Welders who are qualified only on P-91 welding shall be engaged. Welders shall have to undergo all the training all the training above. It may be required that the welders shall have to be tested and and qualified at BHEL / WTC / TRICHY. Contractor shall arrange for the same and entire expenditure towards this shall be borne by the Contractor.

1r CONTROL ON WELDERS

The welders during welding at site shall follow the correct procedures. The welders shall interact with the HT operator (Induction / Resistance equipment operator) to ensure that preheat and inter-pass temperature during welding are maintained as per requirement. The welders shall not mix the welding electrodes with that of the other welder. At the end of the shift, the unused electrodes shall be returned to the stores.

1s PERSONNEL ENGAGED FOR HEATING CYCLE (HT OPERATOR)

Contractor shall deploy adequate no of heat treatment operator / technicians and electricians exclusively in shifts, who shall have adequate heat treatment experience on P-91 or similar material. HT operator shall be aware of the followings :

1. The equipment used and its working principle.
2. The procedure to be followed in using heating equipment.
3. Procedures to be followed in case of power failure or equipment non-functioning.
4. Calibration of equipment
5. Method of fixing the thermocouples and compensating cablesleading to HT recorder.
6. Fixing of heating pads or elements on the pipe joints and also in maintaining the temperature within the specified limits.

1t NDE PERSONNEL QUALIFICATIONS

All the Non-Destructive Examinations shall have to be performed by Qualified NDE personnel only. Ultrasonic Testing , Magnetic Particle Inspection and Liquid Penetrant Inspection shall be carried out by ASNT / ISNT Level – II qualified personnel only.

1u SUPERVISION

Contractor shall deploy exclusive Engineer and Supervisor who will be responsible for the completion of all activities from weld fit-up to final

clearance of weld joints after satisfactory NDE and acceptance by BHEL / Customer / IBR.

1v DO'S AND DON'T'SDURING P-91 WELDING, HEAT TREATMENT AND NDE AT CONSTRUCTION SITE.

DO'S :

1. Cutting by Band saw / Hack saw / Machining / Plasma cutting.
2. Pipe edge preparation by machining. Machining shall be done without excessive pressure to prevent heating up of pipe.
3. Grinding may be done on exceptional cases taking adequate care to prevent overheating.
4. Thermocouple wire (hot / cold junctions) shall be welded with condenser discharge portable spot-welding equipment.
5. Reserve thermocouples shall be made available, in case of failure of connected thermocouple elements.
6. Ensure adequate Argon gas for complete purging of air inside the pipe before starting GTAW root welding.
7. Ensure preheating at 220 deg. C minimum before GTAW root welding.
8. Start preheating only after clearance from welding engineer / Quality assurance engineer for weld fit-up and alignment of the joint as well as fixing of Thermocouples (for Induction heating).
9. Do visual inspection on root weld maintaining weld preheat temperature.
10. Continue Argon purging until the GTAW root welding followed by minimum two filler passes of SMAW is complete.
11. Perform partial root welding to facilitate fit-up, if necessary.
12. Ensure that only one layer of root welding using TGS 2CM filler wire is deposited wherever necessary.
13. Ensure proper use of TIG wires as identified by colour coding or suitable hard punching.
14. Keep the GTAW wires in absolutely clean condition and free from oil , rust etc.
15. Dry the SMAW electrodes before use.
16. Ensure inter-pass temperature is less that 350 deg. C.

17. Hold at 80-100 deg. C for a period of minimum 1 Hr. before start of PWHT.
18. Record entire heating cycle on chart through recorders.
19. Exercise control during grinding of weld and adjoining base metal while removing surface surface / sub-surface defects or during preparation of NDE.
20. Ensure no contact with moisture during preheat, welding , post heat and PWHT of weld joints.
21. Ensure removal of Argon purging arrangements after welding.
22. Use short Arc only. The maximum weaving shall be limited to 1.5 times the dia of the electrode.
23. Obtain WPS from equipment / piping supplier (combination welding) for welding of Pipe with equipment.

DON'T'S

1. Avoid Oxy-Acetylene flame cutting.
2. Avoid weld-build up to correct the weld end or to set right the lip of the weld bevel.
3. Avoid Arc strike on materials at the time of weld fit-up during welding.
4. Do not tack weld the thermocouple wires with manual ARC / TIG welding.
5. No GTAW root welding without thorough purging of root area.
6. Do not use Oxy-Acetylene flame heating for any heating requirement.
7. Do not use thermal chalks on the weld groove.
8. Do not stop Argon purging till completion of GTAW root welding and two layers of SMAW.
9. No tack welding or Bridge piece welding is permitted.
10. Do not use unidentified TIG wires or electrodes.
11. Do not exceed the maximum inter-pass temperature indicated in WPS.
12. Do not allow moisture, rain, water, cold wind, cold draft etc. to come in contact with the weld zone during the entire cycle from preheat to PWHT.
13. Do not exceed the limits of PWHT soaking temperature.
14. Do not interrupt the welding / heating cycle except for unavoidable power failures.

15. Do not use uncalibrated equipment for temperature measurement during heating, welding, post-weld heat treatment etc.

1w FACILITY TO BE PROVIDED BY THE CONTRACTOR FOR P-91 WELDING

1. Required numbers of operators / technicians / electricians for installation, commissioning and operation continuously.

2. Induction heating machine as per following :

   a. Induction Heating Machines with accessories.
   b. The following consumables :
      (i) Annealing Cables
      (ii) Compensating Cables
   c. Welding electrodes for P-91 welding.
   d. Digital Temperature indicator.

   The contractor shall provide electrical cables and switches required. All the equipment shall be protected by providing covers or sheds at site by the contractor within the quoted rate. Any loss / damage of equipment / tools by the contractor shall be recovered from the contractor.

3. Gas burner arrangement with required gas for maintaining temperature in the event of power failure.

4. Ultrasonic flaw detector with recording Device & Complete accessories (Digital Type - Krautkramer model USN 50 or equivalent) capable of storing calibration data. All recordable indications will be stored in the memory of the digital flaw detector and in PC (to be arranged by contractor within his quoted rate) for review at a later period.

5. Spot welding Machine for fixing Thermo-couples.

6. EQUOTIP or MICRODUR make or equivalent portable hardness tester.

7. MPI & LPI kit with required consumables.

8. Consumables :

1 Glass Fibre Cloth - 1 mm x 1000 mm - Temperature rating 1260 deg. C.

2. Glass Fibre cord - Dia 3 mm (Twisted) - Temperature rating - 1260 deg. C.

3. Ceramic Fibre Blanket - RT Grade, Density 96 KG / Cub. M - Temperature rating - 1260 deg. C.

(iv) Ceramic Fibre rope - Fibre glass braided, dia 12mm - Temperature rating 1260 deg. C.

(v) K- Type Thermocouple - 0.5 mm Dia single strand individual fibre glass insulated.

(vi) Heavy duty TC connectors for K- Type Thermocouples – Size 0.5 mm dia single strand individual fibre galss insulated.

(vii) All other consumables / equipment required to carry out the work.

1x TECHNICALLY APPROVED BRANDS BY BHEL / HPBP- TRICHY.

Liquid penetrant , penetrant remover (solvent cleaner) and Aerosol Developer from the same manufacturer considered as a family group.

VENDOR	**PENETRANT**	**BRAND**	
		PENETRANT	DEVELOPER
		REMOVER	
ITW SIGNODE (I) LTD.	STOPCHECK	STOP CHECK	STOP CHECK
	SKL – SP	SKC – 1	SKD – S2
P – MET CO.	FLAW CHECK	FLAW CHECK	FLAW CHECK
	I) PP – 15	I) PP- 21	I) PP - 31A
	II) PP – 110	II) PP – 120	II) PP – 131A
CHECKMATE CHEM. PVT. LTD.	CHECKMATE	CHECKMATE	CHECKMATE
	SUPER	SUPER	SUPER
	PT – 97	CL – 96	DV – 98
PRADEEP METAL	FLAW GUIDE	FLAW GUIDE	FLAW GUIDE

TREATMENT GP GP
GP

FERRO CHEM CRACK CHECK CRACK CHECK CRACK CHECK
FC – 911 FC – 911 FC –
911

DRY MAGNETIC POWDER :

1. MAGNAFLUX - PRODUCT GREY , 8A -- RED

2. FERROCHEM PRODUCT NO. 256

3. K – ELECTRONICS PRODUCT -- RD -- 200 (SPECIAL)

NON – FLOROSCENT MAGNETIC INK
(PREPARE BATH AS INSTRUCTED BY SUPPLIER)

1. MAGNAFLUX -- PRODUCT 9C RED WITH MX/MG CARRIER II OIL VEHICLE.

2. FERROCHEM -- PRODUCT NO. 146A WITH OIL VEHICLE (WITH HIGH FLASH POINT 92 DEG. C.)

3. SARDA MAGNA CHECK INK WITH OIL VEHICLE (WITH HIGH FLASH POINT 92 DEG. C)

FLUOROSCENT MAGNETIC INK
(PREPARE BATH AS INSTRUCTED BY SUPPLIER)

1. MAGNA FLUX -- PRODUCT 14 A WITH MX/MG CARRIER II OIL VEHICLE.
2. MAGNA FLUX -- PRODUCT 14 AM - PREPARED BATH OF 14 A AND MG / MX CARRIER-II READY TO USE WITHOUT MEASURING AND MIXING IN AEROSOL CONTAINER WITH MX/MG CARRIER-II OILL VEHICLE.

2. **STORAGE OF MATERIALS** : Around 50% of the total materials for this STG set shall have to be unloaded and stored temporarily before erection in the storage space provided at The Agrico Plant, Golmori in Jamshedpur which is about 5~6 KM away from the project site.The necessary T&Ps for unloading from trucks/trailers,storing/stacking and reloading on contractors own trucks/trailers for shifting to the project site during erection to be arranged by the contractor. The trucks/trailers required for transportation of these materials from the storage yard at Golmori to the project site is to be arranged by the contractor.

Storage space shall be provided on the operating floor,unloading bay and in the area outside A-row of the power house for unloading and storage of the balance plant materials.

3. It may be noted that turbine insulation is excluded from the scope of this contract. However, the application of insulation for the piping area is included in the contractor's scope. Revised billing schedule for erection is attached.

4. Payment for unloading of generator stator has been covered under the erection billing schedule. As such, payment for unloading of the generator stator will not be considered under material management works.

ANNEXURE-V (TENDER NO. PSER:SCT:JSD-TM764:07)

BILLING SCHEDULE FOR ERECTION & COMMISSIONING OF TG & AUX.PIPING PACKAGE AT 1x120MW STG SET AT TISCO POWER HOUSE NO.6,JAMSHEDPUR

Note:	1) Payment shall be released on Pro - rata monthly basis on each item of works against submission of bills.	
	2) It may please be noted that the break up given above is notional break up only, solely to facilitate progress billing thereof. The lump-sum contract price and contract conditions shall remain unchanged and difference, if any, shall be adjusted in accordance with total individual allocation as above and shall be paid alongwith the last pro-rata bill for individual item.	
	3) Items not appearing in the above break-up but required for the purpose of system completion as per technical specification / drawing shall be executed with out any cross reference to the payment break-up and no additional payment shall be released by BHEL.	
SL. NO.	**ACTIVITY DESCRIPTION**	**PERCENTAGE OF BILLING (of CV)**
A	**CONDENSER (18%)**	
1	**Foundation preparation**	1.50%
2.1	Completion of box.assy.including welding	1.50%
2.2	Erection & Welding of Tube Support plates	2.00%
2.3	Erection of dome walls lower & upper and welding	1.50%
2.4	Erection of stiffeners/bracing pipes of dome walls	1.00%
2.5	Welding of stiffeners/bracing pipes	1.00%
2.6	Erection & welding of stiffeners etc.of condenser	1.00%
3.1	Insertion of Tubes	1.50%
3.2	Trimming, expansion	3.00%
3.3	Water fill test of tubes from outside	1.00%
3.4	Erection and bolting of water boxes	1.00%
4.1	Hydraulic test of condenser tubes & water box	0.50%
4.2	Condenser neck erection, alignment with LP exhaust & welding,Condenser painting	1.50%
B	**TURBINE (19%)**	
1	Chipping of foundation , levelling and placement of Turbine Brg.Pedestals and base plates etc.	1.00%
2	Grouting of Brg.pedestals/sole plates	2.00%
3	Foundation bolts stretching	0.50%
4	Placement of Outer Casing B/H & alignment	1.00%
5	Placement of rotor and preliminary alignment	1.00%
6	Checking of radial & axial clearances	1.00%
7	Placement of top half and centering	1.00%
8	Trial assembly of turbine and checking clerances	1.50%
9	Final axial & radial key fitting	1.00%
10	Coupling holes reaming/honning & bolts Machning , fittings and radial run out check	1.50%
11	Erection of M.S. Stop cum control valves	1.00%
12	Erection of Gov. Control rack ,Oil Units and related items ,gov.system items,piping etc.	1.50%
13	Boxing up of Turbine & Heat tightening of Parting joint bolts	2.00%
14	Erection & welding of of extraction pipes inside the steam space of condenser	1.00%
15	Erection & welding of Steam inlet pipe/bellow joints	0.50%
16	Erection of QCNRVs, Gov.system items and piping.	1.50%
C	**GENERATOR (8%)**	
1	Matching embedded plates & foundation frame	0.50%

SL. NO.	ACTIVITY DESCRIPTION	PERCENTAGE OF BILLING (of CV)
2	Erection of the temporary structure for generator stator lifting including alignment,bolting welding,grouting of columns,providing assistance for unloading & Shifting of Generator Stator to its foundation on placement and dismantling,shiting & loading of the materials to transporter's truck/trailer after completion of the stator lifting activity.	2.00%
3	Threading of Rotor	1.00%
4	Alignment of Generator Rotor with Turbine rotor and coupling	2.00%
5	Erection of CO2 system & ducting & all other works	1.50%
6	Erection of Exciter & AVR	1.00%
D	**AUXILIARIES (25%)**	
D1	**Erection & Commissioning of CEPs(2%)**	
1.1	Erection of CEP-A	0.80%
1.2	First trial run (8 hrs.) for CEP-A	0.20%
2.1	Erection of CEP-B	0.80%
2.2	First trial run (8 hrs.) for CEP-B	0.20%
D2	**Erection & Commissioning of BFPs**	
	Erection & Commissioning of BFP-A	
	Foundation chipping, blue matching of foundation and levelling, centring of grillage/foundation frame and bolt grouting and grouting in totality	0.75%
	Placement of feed pump, booster pump, motor, lub oil unit, seal water cooler,suction strainer, recirculation control valve, connecting coupling and preliminary alignment.	0.75%
	Grouting of grillage/ foundation and final alignment of BFP, BP Motor and HC	0.50%
	Erection of lube. Oil piping, & other balance piping like mechanical seal etc, Erection of panel/racks and oil flushing of oil piping	0.50%
	Trial run of BFPs (8 Hrs)	0.50%
	Erection & Commissioning of BFP-B	
	Foundation chipping, blue matching of foundation and levelling, centring of grillage/foundation frame and bolt grouting and grouting in totality	0.75%
	Placement of feed pump, booster pump, motor, lub oil unit, seal water cooler,suction strainer, recirculation control valve, connecting coupling and preliminary alignment.	0.75%
	Grouting of grillage/ foundation and final alignment of BFP, BP Motor and HC	0.50%
	Erection of lube. Oil piping, & other balance piping like mechanical seal etc, Erection of panel/racks and oil flushing of oil piping	0.50%
	Trial run of BFPs (8 Hrs)	0.50%
	Erection & Commissioning of BFP-C	
	Foundation chipping, blue matching of foundation and levelling, centring of grillage/foundation frame and bolt grouting and grouting in totality	0.75%
	Placement of feed pump, booster pump, motor, lub oil unit, seal water cooler,suction strainer, recirculation control valve, connecting coupling and preliminary alignment.	0.75%
	Grouting of grillage/ foundation and final alignment of BFP, BP Motor and HC	0.50%
	Erection of lube. Oil piping, & other balance piping like mechanical seal etc, Erection of panel/racks and oil flushing of oil piping	0.50%
	Trial run of BFPs (8 Hrs)	0.50%
D3	Erection of TG Lub oil equipment including MOT,Lub oil pumps,Jacking Oil Pumps,Oil Centrifuge etc.	1.50%
D4	Erection of Static Aux.covered in Turbine & Generator oil & water system	1.00%
D5.1	Placement and alignment of HP Heaters 1&2	0.75%
D5.2	Placement & erection of LPH	0.75%

SL. NO.	ACTIVITY DESCRIPTION	PERCENTAGE OF BILLING (of CV)
D5.3	Placement and alignment of Steam Jet Air Ejector, Oil Coolers,Generator Air Cooler & Gland Steam Condenser	1.00%
D6	Erection of Deaerator & Feed Storage tanks and other flash tanks connected with condenser(3%)	
D 6.1	Placement and alignment of Deaerator and Feed Storage Tanks	2.00%
D6.2	Welding & NDT of joints of Feed Storage Tank,Hydrotest	1.00%
D6.3	**Misc. Tanks & Equipment,HPBP system & TG Integral Piping(6%)**	
1	Erection & Welding of Turbine , Generator lub oil,jacking oil piping	1.00%
2	Erection of Gland Steam Piping covered in TG Integral piping(BHEL/Hyd.scope)	1.00%
3	Erection of Turbine drainage piping	1.00%
4	Arrangement for preparation of TG Lub oil System piping for starting of flushing	1.00%
5	Erection and placement of Misc. Tanks other than DA & FST	1.00%
6	HPBP system with oil units and associated items	1.00%
E	**Balance of Plants-PIPING(14%)**	
E1	HP Extraction steam piping (turbine outlet to HPH-1 &2 inlet)	0.75%
E2	MP Extraction steam piping (turbine outlet to DA inlet)	0.50%
E3	LP Extraction steam piping (turbine outlet to LPH inlet)	0.75%
E4	Turbine exhaust hood spray piping	0.75%
E5	Aux. steam piping incl. PRDS from live steam to DA cxcept aux. steam header & part piping as per turbine cycle scheme	0.75%
E6	Aux. steam piping incl. PRDS from live steam to ejector & turbine glands cxcept aux. steam header & part piping as per turbine cycle scheme	0.75%
E7	Feedwater piping from DA to outlet of HPH	0.75%
E8	Recirculation piping from BFP to DA	1.00%
E9	DM water make up piping	0.75%
E10	Condensate piping from hotwell outlet to inlet of DA	0.75%
E11	Condensate dump piping from CEP discharge to outlet of control station	0.50%
E12	Service & Instrument air piping inside TG building	0.50%
E13	ACW supply & return piping at 1M outside TG hall to TG auxiliaries	0.75%
E14	Drain & vent piping	0.50%
F15	LP dosing system for hydrazine & amonia	0.50%
E16	Thermal insulation for piping	1.75%
E17	Insulation of FST,Deaerator ,LP /HP Heaters , GSC,Ejectors and other equipmet erected by the vendor.	2.00%
F	**PRE-COMMISSIONING & COMMISSIONING (16%)**	
1	Start of Oil flushing	1.00%
2	Completion of oil flushing & normalisation for TG on turning Gear	1.00%
3	Barring Gear	1.00%
4	CONDENSER FLOOD TEST	1.00%
5	Vacuum pulling with gland steam (first time commissioning)	1.00%
7	Rolling , eletrical testing and synchronisation	1.00%
9	Full loading	1.00%
10	Finish painting	3.00%
11	Liquidation/Completion of pending/punch points	4.00%
12	TRIAL RUN COMPLETION (ON HANDING OVER TO CUSTOMER)	1.00%
13	PG TEST COMPLETION	1.00%
	GRAND TOTAL	**100.00%**