

Bokaro Power Supply Co. (P) Ltd.

(A Joint Venture of SAIL & DVC)

Hall No: - M-01, Old Administrative Building,
Ispat Bhavan, Bokaro Steel City – 827001

Ref: BPSCL/P&C/18-19/C-196/NIT-791/2748

Dated 02/08/2019

AMENDMENT / EXTENSION OF BID OPENING DATE

NIT No. / Date	Description of items / jobs				
NIT No.: BPSCL/P&C/18-19/C-196 /NIT-791/969 dated 14/03/2019	Capital Repair & RLA of Turbo Generator # 2.				
<p>1. Scope of Work (Annexure-III) and Special Terms & Condition (Annexure-IV) has been amended and same may be read as per Revised Annexure III & Revised Annexure IV in place of existing annexures.</p> <p>2. Bid Opening Date is being extended as below:</p> <table border="1"><thead><tr><th>Extended Bid Submission Date & Time</th><th>Extended Bid Opening Date & Time</th></tr></thead><tbody><tr><td>20/08/2019 at 12:00 Hrs. (IST)</td><td>20/08/2019 at 12:15 Hrs. (IST)</td></tr></tbody></table>		Extended Bid Submission Date & Time	Extended Bid Opening Date & Time	20/08/2019 at 12:00 Hrs. (IST)	20/08/2019 at 12:15 Hrs. (IST)
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Enclosures: <i>a. Revised Annexure-III: Scope of Work (10 pages)</i> <i>b. Revised Annexure-IV: Special Terms & Condition (04 pages)</i>					

For detailed NIT and Tender Document please visit our website: www.bpscl.com

For and on behalf of BPSCL

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02.8.19

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Scope of Work:

PART-1: CAPITAL REPAIR OF TURBINE & GENERATOR (with their AUXILIARIES)

A. Turbine (Capacity- 55MW, Make- LMZ, Russia)

1. Recording of all relevant operational parameters before stopping.
2. Removal of thermal insulation of the turbine components and pipelines (about 5m length).
3. Barricading of the working area and shifting of all T&P & storing it properly on TG floor.
4. Opening of front pedestal cover and removal of all governing system items. Recording of turbine float, bump, seal bores etc. for reference
5. Removal of the barring gear and bearing top covers.
6. Hot loosening of the HP parting plane bolts and cap nuts, wherever necessary cap nuts and studs are to be cut only after the instruction of engineer in charge. Machine & operator should reach site well in advance so that there is no delay due to its non availability.
7. Lifting of top casing.
8. Taking the Rotor run out, checking swing, taking seal bore, alignment reading. Bearing top half removal, alignment reading, decoupling of Turbine & Generator rotor.
9. Checking bearing interferences and oil clearance and seal clearance. Repairing of the bearing pedestal load bearing areas shall be carried out by local repair & subsequently by blue matching with respective pads.
10. Checking of journal slopes & pedestal slope.
11. Checking of steam flow path clearance & float of the rotor.
12. Removal of thrust pad.
13. Removal of rotor.
14. Removal of top & bottom liners and diaphragms. The party shall carryout repairs on diaphragms in all accessible areas where repairs are technically feasible. Recording the thermal clearances of the top diaphragms/casing. Repair of diaphragm blades profile is not under this scope. However, after assessment if any such requirement comes, we shall discuss the modality of repair as agreed by both parties. In case of replacement of diaphragms, all machining activities related to fitment of diaphragms shall be in BPSCL Scope.
15. Cleaning of rotor diaphragms, Liners, gland seal boxes by alumina blasting/manual
16. Cleaning of the parting plane and checking of thermal distortion of the parting planes. Minor & localized weld repair (to the extent required in consultation with the engineer in charge) of casing, lining diaphragms, seal boxes by proper welding and blue matching. Special electrodes will have to be supplied by the contractor.
17. Cleaning of all the components including rotor, diaphragm, seal boxes, liners etc to be done by alumina blasting process / manually with consent of the EIC.
18. Repair/replacement of the nozzle segments of the cylinder, MPI of casing and nozzle box areas, Diaphragms, carriers, Gland of the turbine are to be carried out by contractor. If nozzle box stationary blades are found damaged beyond acceptable limit, then the same has to be repaired by the contractor.
All grinding and welding of cracks (*detected during overhauling*) to be carried out by contractor. If any defect is noticed the same is to be rectified/ replaced. Any specialized welder, welding rod, flux and welding Engineer required for this purpose will be brought by contractor. Pre heating and stress relieving required will be carried out by contractor at no extra cost.
19. All the internal threads in casings, bearing pedestals and bearing covers are to be tapped by same size taps and damaged threads are to be drilled and higher size tapping is to be done, any dowels or locating pins if required are to be reamed to new sizes and to be replaced. All taps and drilling machines are to be arranged by Contractor.
20. Seal bore readings are to be corrected by adjustments of shims wherever feasible. Efforts should be made to ensure that the position of the bearing bottoms are concentric to the centre line of the casing and seal bore readings are to be recorded after completion of the alignment. Seal bore correction by machining is not in the scope of contractor.
21. Removal of the generator rotor. Removal of bearings, repair/ replacement of all the bearings after the DPT and Ultrasonic testing and readjustment of the bearing clearances as per standard values and re- assembly. Replacement of old coupling and fixing of new coupling is not in the scope of contractor.

22. Testing of all the bearings by VI, DPT, and UT and replacement of the defective ones and readjustment of the bearing clearances as per standard values and reassembly. Alignment of rotors and finalizing the positioning of the bearings.
23. Cleaning and lubrication of the sliding surfaces of the front pedestal for improving free sliding over the key. Clearance recording for MOP and necessary repair or replacements of bearings as per need.
24. Replacement after inspection of the thrust bearing if required. Assembly of the thrust bearing checking/adjustment of the float.
25. Centering of all the diaphragms and internals. Sealing ring adjustment by new one or old one is to be done as per OEM standards. Thermal clearance of diaphragms with carrier's bottom and top casing is to be done. For this all grinding and welding required is to be done by contractor. Repair/Replacement of damaged diaphragms by new one, cleaning of exhaust hood sprays nozzles are also to be done by contractor.
26. Check/ adjust steam flow path clearances, axial float, seal clearances, and thermal clearances. Machining jobs required for this purpose is to be done by contractor. Welding and matching (of diaphragms, gland boxes liners etc.) to be done by the contractor. If new seals are fitted in the diaphragms, the clearances of the same are to be adjusted by the contractor.
27. CRO, Bump/swing check of the rotors.
28. Replacement of the parting plane fasteners wherever necessary, boxing up of the top & bottom casings and tightening of the fasteners. In case of PP fastener replacement of the turbine casing, entire set of fasteners need to be replaced.
29. The external surfaces of the casings are to be thoroughly cleaned and then painted with heat resistant Aluminum paint. The paint will be supplied by contractor.
30. Checking the final alignment with normal level in the hot well and C.W pumps in service and making the final corrections. Checking the bearing interference and corrections to be done.
31. Reaming of the coupling holes and coupling the rotors by fixing new/ old coupling bolts as necessary. If any sleeve is to be fitted in any coupling hole then it is in contractor's scope. The machining of the coupling bolts and sleeve will be undertaken by BPSCL. Supply of sleeve material shall be in BPSCL's scope.
32. Preparation for oil flushing and then normalizing of the bearings after oil flushing. For the purpose of oil flushing, if some of the bearings are required to be bypassed/blanked all arrangements for the same to be done by the contractor and necessary de blanking after flushing.
33. Assembly of the cross over pipelines and the leak off and the sealing steam lines. Rectification of any defects during the rolling or on barring gear or during over speed testing pertaining to the workmanship of contractor as per the instruction of Engineer- in – Charge.
34. Trim balancing of the rotor system (In situ balancing).
35. Contractor has to bring **three nos.** of experienced EOT crane operators for operation of 2 x 100/20 Ton EOT cranes at BPSCL for the entire duration of the overhaul (*From the start of the overhaul to the commissioning*). As this job is very critical; most experienced persons are to be deployed with full responsibility of contractor. However, maintenance of EOT crane will be done by BPSCL, but before start of job it will be the operator's duty to check the healthiness of crane. In case of any fault/ abnormality Engineer-In- charge should be informed and crane work should be stopped immediately.
36. Spare Turbine bearings (*Bearing no.1 to 4 along with bearing of MOP*) would be inspected with DPT, MPI and UT by contractor along with Turbine Maintenance team of BPSCL for any defect, well in advance (*Up to one month approx.- The date will be informed to the contractor by Engineer- In –Charge*) of overhauling. All consumables and machines are to be arranged by Contractor. Healthiness of the bearings shall be reported to BPSCL.
37. Oil guard portion of the rotor is to be machined by Contractor as per the manufacturer's norms, if found uneven/worn out.
38. Inspection/Repair of vertical joint of the HP turbine casing by suitable method to prevent leakage of steam from this joint. It may be noted that there is no leakage from the turbine casing, at present.
39. Cleaning of all the components of turbine like rotors, diaphragms, liners etc required for RLA and repair/replacement of same after RLA as per Manufacturer's norms.
40. Overhauling of the barring gear. (complete dismantling, component repair/replacement, as per norms and re-assembly)
41. Overhauling & refurbishment of the governing system along with CVSM, MOP, control valves with operating mechanism, cam shafts, ESVs and barring gear. Lapping and blue matching of the ESV and

Control Valves are to be done. The liners and valve internals of the ESV, control valves and other components of the governing system and CVSM are to be replaced as per requirement. Checking and adjustments of the Governing characteristic. Valve body seat (i.e valve diffuser) replacement is not in the scope. This job shall be dealt separately based on RLA report on mutually agreed time and price. For replacement of liners of HP Control valves, machining of damaged liners for its removal shall be in BPSCL scope.

42. Shifting of the spares to the site from the store and shifting of the unused material and scrap from site to the scrap yard or to stores.
43. Any rerouting/modification of pipe lines/ flanges at turbine floor, directly connected to the turbine are required to be done, if found necessary.
44. As soon as the turbine cylinders are opened, all the steam, extraction and drain lines are to be plugged with wooden plugs/sheet metal and kept in place till the time of box-up to avoid any ingress of foreign materials into the connected pipelines.
45. After overhauling, when the turbine is rolled and loaded, the turbine should run with normal TSI parameters (*Including the bearing vibrations*). It should be ensured that there is no leakage of steam from the parting plane of the turbine or other connecting joints. The contractor shall be at site at least for 72 hrs, after synchronization of machine to attend any defect.
46. This scope of work is indicative but not exhaustive and all the allied works necessary for successful completion of above work during normal overhaul are deemed to have been included in the scope of work and the contractor is responsible for carrying out the same without any extra cost.

B. TURBINE AUXILIARIES:

1. Oil System: -

- a) Removal of oil from MOT, oil coolers, seal oil cooler, transferring to drums supplied, in proper way and keeping them in a safe place for reconditioning.
- b) Dismantling, cleaning of oil coolers (*1 no. seal oil coolers & 4 nos. oil cooler*) tube bundle by nylon brush, hydraulic test of the coolers at a pressure of 1.25 times of the rated Pressure. Plugging, replacement as per instruction of Engineer Incharge.
- c) Re-visioning of the valves which includes tightness testing, proper matching of discs and seat and if required replacement of the same.
- d) Cleaning of MOT and its filters.
- e) Inspection and rectification of any defect of the oil injector.
- f) Assistance in refilling of oil to the MOT.
- g) Changing all existing oil gaskets, cleaning all oil lines. If any pipe line is found thin or damaged, then replacement is to be done as per norms. IBR quality welder is to be arranged by the contractor. Servicing of the oil system valves and their hydro test is to be done. All the lines and valves are to be painted.

2. Oil Pumps :-

- a) Dismantling, re-visioning and reassembly of starting oil pump (01 No), main oil pump, A/C & D/C oil pump (02 Nos.) and seal oil pump (02 Nos.) along with motor.
- b) Damaged or worn out components to be repaired by welding, grinding, polishing as per the instruction of Engineer Incharge.
- c) Re-visioning of pump components, cleaning, run out checking of shaft and coupling, repair coupling, coupling bolts and coupling bush.
- d) Removal and placement of motor, coupled trial run for 72 Hrs.
- e) Servicing of motor is not included in contractor's scope.

3. Seal Oil System :-

- a) Re-visioning of differential pressure Regulars, revising of all the valves associated to seal oil system.
- b) Adjustment of pressure relief valve. Overhauling of seal oil pumps.
- c) Cleaning of seal oil tanks and re-visioning of valves, level controller, level switches, filters and gauge glasses.
- d) Replacement of gaskets of all the associated flanges.

- e) Replacement of damaged impulse lines.
- f) Overhauling of H₂ venting fans.

4. LP Heater, gland steam cooler, ejector, drain cooler :-

- a) Dismantling of cooler bundle.
- b) Cleaning & hydraulic test at 1.25times the rated Pressure.
- c) Plugging of the leaking tube. If required, replacements of tube bundle as per the instruction of Engineer Incharge.
- d) Cleaning, revisioning of gauge glasses, inlet & outlet valves, level switches & associated valve. Replacement of gasket, rubber & washers.

5. Pumps:-CEP (2 nos.):-

- a) Dismantling of the pumps & motor.
- b) Rotor, run out checking.
- c) Building up of the damaged impeller, bearing housing, and worn-out parts if required by welding, grinding and finishing as per the instruction of Engineer Incharge.
- d) Removal of the suction filter, cleaning and box up.
- e) Cleaning/ replacement of the cooling line and sealing line valves.
- f) Assembly and replacement of coupling bushes.
- g) Alignment and trial run for 72hrs at full load.
- h) Inspection and revising of NRV, suction & discharge valve, replacement of worn-out parts. Blue matching of disc & seal.

6. Gas Cooler lift Pumps (02 Nos.):-

- a) Dismantling of the pump & motor removal.
- b) Rotor, run-out checking.
- c) Assembly of the pump, replacement of coupling bush.
- d) Motor placement, alignment and coupling.
- e) Inspection of NRV, inlet & outlet valve, blue matching of disc & seat, replacement of worn out parts if required metal building up and finishing.
- f) Dismantling & cleaning of 02 Nos. of line filter. Replacement of damaged parts.

C. Turbines Valves, Pipes & Supports :

1. Turbine ESV:

- a) Dismantling of the servomotor and its components. Cleaning & checking for their healthiness and repair/ replacement of damaged components.
- b) Dismantling of ESV. Cleaning of the seat & disc.
- c) Proper lapping & blue matching of seat & disc.
- d) Checking of the studs for thermal elongation.
- e) Run out checking of the ESV spindle.
- f) Assembly & boxing up.
- g) Adjustment for proper lightness of ESV as per OEM norms.
- h) Characteristic setting of ESV as per OEM norms.
- i) Any repair or replacement based on RLA Finding, shall be done with no additional cost subject to such repair / replacement being minor, technically feasible & accessible. In case of any major defect the same shall be carried out by the contractor at a cost and time mutually agreed upon.
- j) For replacement of liners of HP Control valves, BPSCL to provide existing workshop facility.

2. NRV Extraction:-

- a) Dismantling of servomotor & valves, L/S etc.
- b) Lapping of valve & disc. Blue matching.
- c) Revising of servomotor.
- d) Assembly and operation checking for tightness and indication.

3. Valves:-

- a) Revising of all the valves along with gearboxes NRVS. ($\text{Ø}150$ to $\text{Ø}600$) – 10nos, ($\text{Ø}25$ – $\text{Ø}100$) – 40 nos. which will comprise of dismantling, lapping & blue matching of disc and seats. Repair of worn out parts by welding & finishing with suitable electrodes as far as possible. Replacement of gland packing and associated gaskets. Hydraulic tests of each valve at 1.25 times the rated Pressure. Damaged valves to be replaced as per the instruction of Engineer In charge.
- b) Dismantling and revising of the level & Pressure Control valves (06 Nos.).

4. Pipes :-

- a) Replacement of high pressure pipe line (NB 15 to NB 20) – about 100meters (joints approx. 30 nos).
- b) Replacement of low pressure pipe line (NB 50 to $\text{Ø}100$) – 50 meters (joints approx. 20).
- c) Replacement of low pressure pipe line ($\text{Ø}100$ to 300) – 30 meters. (joints approx. 15)

The high Pressure Pipes are to be welded by TIG welding by certified high Pressure Welder and Contractor has to submit the certificate before start of job. All joints should be of radiographic quality and UST/ Gamma ray of joints will be carried out by Contractor on random basis as per the Engineer Incharge's discussion. The Contractor will assist to carry out these tests.

For low Pressure Lines arc welding will be allowed but Contractor should engage welder and gas cutter having at least working experience of 5 years of the similar nature.

All high – pressure pipe lines shall be welded by the party. Stress relieving, if required, shall be carried out at additional cost & time as mutually agreed upon.

5. Springs & Supports:-

- a) Inspection of the springs & Supports of steam lines, condenser, extraction lines.
- b) Repair / replacement of damaged components
- c) Fixing of brackets and other accessories properly by welding /bolting.
- d) Adjustment of the spring as per the OEM norms/instruction of engineer in charge.
- e) Replacement of brackets

6. Insulation:-

- a) Complete replacement of top/ bottom casing insulation and corresponding cross over/ leak off pipes re-insulation by spray insulation method with proper density (up to a lead of 10meters). All cladding over the insulation as required.
- b) Drain lines and replica test places by proper thermal insulation.
- c) Plastering and nonflammable painting of the insulation of turbine.
- d) Repair and fixing of cladding covers of turbine which will include changing of part of the frame, sheeting etc.

D. GENERATOR & IT'S AUXILIARIES

1. Recording stator/ rotor IR/PI values before disassembly.
2. Removal and restoration of measuring instruments.
3. Disconnection of the slip ring cables, removal of brush rocker cover/assembly. Check healthiness of current carrying bolts.
4. Removal of slip ring Brush gear.
5. Alignment readings at 2.0 bar air pressure.
6. Breaking of oil seal of Generator.
7. Dismantling of generator rotor diffuser.
8. Dismantling of top cover of bearings Nos. – 3 & 4
9. Removal of top end covers from both sides.
10. Logging of air gap
11. Removal of fan blades of TG rotor.
12. Hanging of Generator for removal of bearing No. – 3 & 4.
13. Threading out of Generator rotor with rail, plate & roller.
14. Inspection of overhang spacers/tying of winding.

15. Cleaning & replacement of putty & re-insulation of terminal bushing.
16. Inspection of core clamping /wedge mapping & re- wedging wherever necessary and necessary repair/ replacement to strengthen them. Only 15% stator re-wedging has been considered.
17. Cleaning and Varnishing of stator and rotor.
18. Thread in of rotor.
19. Placing of main bearings, fixing of end covers & seal bearings & setting in position (if needed new bearings will be provided).
20. Servicing of all hydrogen gas valves, gas coolers water line valves, replacement of all flange gasket, of seal oil & hydrogen line for the entire system. Replacement of valves and erection of new valve as per requirement.
21. Box up of generator and seal restoration.
22. Leakage test to be carried out throughout the hydrogen system before Co₂ filling purging air out.
23. Cutting & Polishing of slip rings and measurement of the slip ring dia before and after polishing. Slip ring groove depth to be measured and groove to be deepened by special lathe if required.
24. Removal & dismantling of all gas coolers, cleaning of gas coolers tubes, hydro-jet cleaning of coolers hydraulic test, painting of coolers, cleaning of gas cooler ducts.
25. Hydraulic test of Gas cooler tubes as per OEM recommendation.
26. Erection/ placement of all gas coolers in position after O/H.
27. Brush gear cable reconnection & assembly of brush gear to be done after O/H. Replacement of all brushes, adjustment of spring tension and checking of proper seating of new brushes
28. Improvement of Pedestal insulation resistance. Check healthiness of insulation washers and insulating sleeves of pedestal foundation bolts. Replace if cracked/damaged.
29. Servicing of hydrogen drier. Replacement of silica gel. Revisioning/ replacement of hydrogen and seal oil system valves.
30. Servicing of hydraulic seal oil tank, buffer tank.
31. Servicing of DPR, seal oil filters.
32. Generator Bus duct support insulator to be cleaned. Bus duct cover's gasket replacement and sealing by putty. Confirm healthiness and tightness of flexible connections. Cracked bus duct insulator, if any, to be replaced.
33. Air tightness test of Generator and complete system to be carried out and immediate re arresting of any leakage.
34. Assembly of seal oil & lube oil pipe lines to be done.
35. Air tightness test of Generator & its gas system pipe lines and all other components of gas system after final assembly to be carried out.
36. Following test are to be carried out on Stator:
 - a) IR & PI measurement.
 - b) DC winding resistance measurement.
 - c) Tan delta and capacitance measurement.
 - d) Partial discharge / corona probe test.
 - e) Computerized digital ELCID test. If any defect is identified in ELCID test / Core Flux test repair of the same shall be carried out by the contractor if feasible at additional cost & time mutually agreed upon.
 - f) DC step voltage / leakage current test.
 - g) RTD element check.
 - h) Natural frequency test on end winding.
37. Following tests are to be carried out on Rotor:
 - a) IR & PI measurement.
 - b) DC winding resistance measurement.
 - c) AC impedance measurement.
 - d) Digital RSO test.
 - e) Pole drop test / voltage balance test.
 - f) Leak test of rotor (after inspection of current carrying bolts). Consumables required for the repair of CC bolt, insulation etc. shall be provided by the contractor.
 - g) N.D.T. of necessary places on rotors.

E. COMMISSIONING

- a) Oil flushing and leakage rectification.
- b) Help in re-fixing of turbovisory sensors, all temperature measuring sensors of turbine casing, front pedestal and generator stator.
- c) Assistance in rolling & trim balancing at optimum level.
- d) Stabilization at Full load/ maximum load for 72 hours.

PART-2: RLA OF TURBINE & GENERATOR

The scope of work is restricted to the **R.L.A. and condition assessment** of main Turbine Type – K-50-90-4 , Make –LMZ, Russia (Turbo Generator#2) , **it's Auxiliaries and Generator.** (Details as per following)
The party shall employ latest and all necessary methodology for the execution of job.

A. List of equipment covered is as following.

1. TURBINE

1.1. Main casing (top and bottom)

- a) Parting planes
- b) Nozzle boxes
- c) Curtis chamber groove
- d) Liner/Diaphragm grooves
- e) Parting plane bolts/grooves
- f) Extraction pipes
- g) Cross over pipes
- h) H.P. control/ stop valves
- i) Condenser
- j) Governing system

1.2. Rotor

- a) Boroscopic hole checking
- b) Blades
- c) Blade roots (last two stages)
- d) Curtis stage collar
- e) Bearings/ journal
- f) Gland seals collars
- g) Oil seal journal
- h) Natural frequency test of blades (Last two stages)

1.3. Auxiliaries

- a) Steam pipes 100 ata / 540⁰C
- b) Steam pipes bends/T joints
- c) Hanger supports and springs. Weld joints of hanger supports
- d) Condenser
- e) LP Heaters

2. GENERATOR

2.1. Stator

- a) Windings
- b) Core Laminations
- c) Wedges
- d) Bushings

2.2. Rotor

- a) Retaining rings
- b) Current carrying bolts
- c) Windings
- d) Bearing journals

2.3. Auxiliaries

- a) Carbon brush gear
- b) Hydrogen gas coolers
- c) Seal oil system

d) Bearings of seal oil and main

B. DESCRIPTION OF JOB:

1. Party should generate required / additional data for the study, from the control room log sheets / history books of customer regarding major failures, modification done on equipments and any significant abnormalities. The Contractor shall compare the present data with the rated values for assessing the present status. Vibration measurement and signature analysis should be done as part of condition assessment.
2. Party should observe the machine in running condition after capital repair (*as at present the machine is already under shutdown*) to evaluate the deficiencies from rated value, behavior of machine. Contractor has to study the present supports system of pipe lines.
3. After the disassembly of the Turbine/Generator Contractor shall do detailed study of all individual components as required to assess general condition /extent of damages/deviation from design values. These should be properly recorded and intimated for further course of action.

C. TEST PROCEDURES:

1. **NON DESTRUCTIVE TESTS:** This includes all tests like U.T., D.P.T., M.P.I, Metallography, Eddy current test, Hardness, Chemical analysis etc.
2. **DESTRUCTIVE TESTS:** This includes deposit chemical analysis test of condenser tube and deposits on turbine rotor & stator blades
3. **VISUAL INSPECTIONS:** This includes physical examination of parts for cracks/ bulges/ breakages/ erosion/corrosion/ pitting etc. All /any deposits found during above inspection should be sent for Chemical analysis. All external inspection defects should be supported by photographs clearly indicating the defective area. Boroscopic inspection for Steam line before E.S.V. should be done for detecting internal cracks/deposits.

D. Residual Life Assessment/ Condition Assessment for Turbine

R.L.A. of all the parts in detail as per mentioned scope through the above mentioned procedures should be done to assess the remaining life span of the equipment. Number of points selected for testing should be as mutually agreed upon and selection of points should be so to assess the condition. The various inspection procedures at different points are as following.

SI. No.	Region/component	Tests to be done (detail given at note)	No. of points
1.	Turbine internals		
	Parting plane of turbine casings	1,3,5,6,	As needed
	Liners	1,3,5,6,	5
	Diaphragms	1,3,5,6,	15
	Gland boxes	1,3,6,7	3
	Liners/ Diaphragm grooves	1,3,4	8
	Parting plane studs and cap nuts	1,4,6,7	24
	Nozzle box	1,3,5,6	3
	Extraction lines joints	1,2,8	6
	Keys and keyways	1,4	6
2.	Rotor		
	Surface	1,3,7,10,11	As needed
	Moving blades	1,3,12(last two stage)	As needed
	Shrouds	1,3,4	As needed
	Blade roots	1,3(last two stage)	As needed
	Rotor bore	1,13	1
	Journal	1,2,4,7	3
	Curties disc	1,3,5,11	4
	Stellited portions	1,4	As needed
	Coupling bolts, sleeves and nuts	1,2,6,7	12
3.	Valves (E.S.V. and H.P. control valve)		
	Valve chamber	1,3,4,5,6,	5
	Valve cone	1,3,4	5
	Spindle	1,3,4	5

	Seat	1,3,4	5
	Studs and cap nuts	1,4,6,7	20
4.	Pipe lines		
	Crossover pipes	1,2,3,5,6,7,8,	12
	Pipe after valve 215	1,4,5,6,7,8	2
	T joint before C.Vs.	1,4,5,6,7,8	8
	Leak off steam line	1,4,5,6,7	6
5.	Auxiliaries		
	Journal bearings/ Pedestal & Bearing Housings	1,2,4,7	6
	Condenser tubes	9,11	5000
	Condenser shell	1,4,8	10
	Support springs	1	10
6.	Pipes Hanger supports	1	10
7.	HP Heaters	1,2,4,8	1000
8.	LP Heaters , Gland steam cooler, ejectors	1,2,8,9	300

Note:

1. Number of points for **INSITU METALLOGRAPHY** checking is approx. 60 nos. Locations to be mutually agreed upon.
2. All the tests mentioned ABOVE are not exhaustive. Any other test needed for successful evaluation of R.L.A. has to be done by the Contractor within the same cost. (*RLA of generator rotor retaining ring and overhang is excluded.*)

3. Detail of Tests:

- | | |
|------------|---------------------------|
| 1. V.I | VISUAL INSPECTION |
| 2. U.T | ULTRASONIC TESTING |
| 3. M.P.I. | MAGNETIC PARTICLE TESTING |
| 4. L.P. | LIQUID PENETRANT TEST |
| 5. I.M. | INSITU METALLOGRAPHY |
| 6. H.M. | HARDNESS MEASUREMENT |
| 7. D.M. | DIMENSIONAL MEASUREMENT |
| 8. T.M. | THICKNESS MEASUREMENT |
| 9. E.C.T. | EDDY CURRENT TESTING |
| 10. S.A. | STRESS ANALYSIS |
| 11. C.A. | CHEMICAL ANALYSIS |
| 12. N.F.T. | NATURAL FREQUENCY TEST |
| 13. B.I. | BOROSCOPIC INSPECTION |

E. Residual Life Assessment / Condition Assessment for Generator

1. **Hot Analysis:** During operation of Turbo Generator at different operating conditions various parameters for life assessment calculations need to be noted by contractor, like
 - a) Rotor, stator winding and core temperatures
 - b) Measurement of rotor shaft voltage.
 - c) Shaft bearing vibration analysis along with generator casing vibration analysis etc.
 - d) Generator loss in % of output. Generator losses to be calculated as per standard procedure however necessary data will be provided by BPSCL.

2. Cold Analysis:

2.1. STATOR

- a) Visual inspection and photographs of parts, over heating signs if any.
- b) Stator laminations checking (core compactness).
- c) Stator wedges tightness checks.
- d) End winding supports
- e) ELCID test
- f) Tan Delta test, stator capacitance measurement, Dielectric loss etc.
- g) Stator winding insulation resistance checking and leakage current checks.
- h) Stator winding resistance measurements.
- i) High voltage test of stator winding.
- j) Partial Discharge test.

2.2. ROTOR

- a) Visual inspection and photographic evidence, overheating signs if any.
- b) U.T of retaining rings , and all other parts like journals, collars and seal surfaces.
- c) Hardness, M.P.I. and D.P. of slip rings of brush gear.
- d) Tightness test of end leads.
- e) Rotor winding resistance measurements & inter turn short circuit testing by surge comparison method (RSO).
- f) Rotor winding insulation measurements & leakage current measurements.
- g) Checking of brush gear insulation brush holder, surface, spring tension
- h) Journal bearing like main and seal system checks for cracks improper adhesion and deformity of babbitt metal. seal bearing & oil catchers
- i) Bearing housing and supports U.T& D.P.T.
- j) Bearing supports insulation checking.
- k) Hydrogen coolers chemical analysis of deposits in the tubes.

All the tests mentioned above are not exhaustive. Any other test needed for successful evaluation of R.L.A. has to be done by contractor at no extra cost.

SPECIAL TERMS & CONDITIONS

1. For RLA:

1. Supply, erection, calibration and operation of all kinds of tools and instruments necessary for the successful execution of work is contractor's responsibility. The calibration details are to be certified by BPSCL before start of job and all calibration certificates should be supplied at least 10 days before start of job.
2. Removal of insulation for preparation of point and spray insulation after analysis is contractor's responsibility.
3. Wherever M.P.I. is done it should be of Fluorescent nature using U.V. Light.
4. All reports regarding replica should be supplied with micrographs not Xerox copies.
5. Contractor, if comes across any part severely damaged, shall immediately informed to the Engineer Incharge about it and ensure proper repair through testing.
6. Contractor shall also provide Root Cause Analysis for the defect found and recommendations for remedy.
7. Any and all generic problems with this machine should be recorded after consultation with BPSCL and O.E.M and necessary remedy should be suggested.
8. Rotor boroscopic hole plug dimension & material composition to be supplied by contractor. Removal of plug for inspection and refixing is contractor's responsibility.
9. Steam path audit is in contractor's scope.
10. Hanger supports to be inspected.
11. For the RLA of H.P Heaters disassembly of shells (*after all pipe line connection disassembly*) and reassembly after RLA in under contractor's scope.
12. For the RLA of L.P Heaters, Ejectors, Gland steam coolers disassembly of shells (*after all connections disassembly*) and reassembly after RLA is under contractor's scope.
13. Final RLA report shall be submitted within 03 months after completion of work.

14. STANDARDS TO FOLLOW

- a) ASME power test code for turbine – PTC 6 S
- b) ASME power test code for steam condenser – PTC 12.2
- c) ASME PTC 12.1 or heat exchangers
- d) ASME – B 31.1 – 1995 POWER PIPING
- e) ASNT –SNT-TC-1A Qualification and certification of NDT
- f) Personnel

<ul style="list-style-type: none"> • ASTM E – 165 • ASTM E-709 • ASTM A –275/A-275M • ASTM E –114 • ASTM E –587 • ASTM A-418 • ASTM E-1158 • ASTM E-804 • ASTM E-164 • ASTM E-7797 • ASTM E-309 • ASTM E-1030 	<ul style="list-style-type: none"> Test method for penetrant examinations Standard guide for magnetic particle examination Standard for M.P.E of steel forgings Standard for pulse echo straight beam ultrasonic exam by contract method Standard angle beam ultrasonic test by contract method Practices for ultrasonic test for turbine /generator rotor forgings Standard guide for material selection and fabrication of reference blocks for the pulsed longitudinal wave ultrasonic exam of metals and metal alloy production material. Calibration of ultrasonic test system by extra flat bottom hole sizes. Standard for ultrasonic test of weldings Standard for testing thickness by pulse echo method Practices for Eddy current exam of steel tubular products using magnetic saturation Standard for radiographic test of metal castings
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- ASTM E-3032 Standard for radiographic test of WELDINGS
 - ASTM E-1351 Standard for production and evaluation of field metallographic replicas
 - ASTM E- 45 Standard practice for determining inclusion content of steel
 - ASTM E-112 Test method for determining average grain size
 - ASTM E – 139 Practices for conducting creep, creep rupture and stress rupture tests of metallic materials
 - ASTM E- 1444 Standard for magnetic particle examination
 - ASTM A-472 Test methods for head stability of steam turbine shafts and rotor forgings
- g) IEC 34 for rotating electrical machine code
- h) VDE 0530 for rotating electrical machine code
- i) BSS 4999 for rotating electrical machine code
- j) BS 2757 for classification of insulating material.

2. **For Capital Repair:**

1. Contractor has to submit bar/PERT chart for schedule from receipt of permit to final commissioning date and get certified by the Engineer Incharge.
2. Contractor's tools and tackles, slings and all lifting tackles should have valid test certificates issued by competent persons (as approved by Chief Inspector of factories, Government of Jharkhand). These certificates are to be produced to Engineer Incharge before start of job.
3. Contractor will have to arrange his own lodging, boarding and local transporting facilities for his entire team.
4. All tools, tackles necessary for execution of the job has to be arranged by Contractor
5. Contractor has to deploy persons every day including holidays & Sundays, whenever necessary extra man power has to be deployed as per the instruction of Engineer in – charge.
6. Job has to be executed round the clock.
7. Defect Liability period for the repaired work shall be 06 months from date of commissioning after repair. Defects found due to poor workmanship within this period have to be liquidated by the Contractor at no extra cost.
8. Shifting of items from site stores, gantry area and disposal of scrap to a distance of 200 meters is Contractor's responsibility.
9. No idle cost will be entertained.
10. Any major additional work (*in case of unexpected severe damage found after opening the casing*) which is not specifically mentioned in this document but felt essential for commissioning of the machine shall be carried out by you at additional price mutually agreed upon.
11. **Subletting Clause:** Contractor may engage subcontractor (*having adequate experience of similar types of jobs*) for this job (*Technical & Financial Credential of subcontractor to be submitted for approval*). Deployment of subcontractors will subject to approval by BPSCL. However the job shall be done under your technical & administrative control. Engagement of subcontractor will not relieve you from any of your responsibility.
12. Minor defects found in RLA has to be rectified by the contractor, free of cost.
13. Dismantling of blades is not in this scope.
14. Bore plug materials and Liquid Nitrogen will be provided by BPSCL.
15. NFT design value range will be provided by BPSCL.
16. Time taken for the scope of work as per RFQ shall be 35 days (from the date of issue of work permit). It is assumed that TG set shall be rolled and synchronized within 48 Hrs. of getting clearance for rolling from the contractor's side.
17. All the Consumables, required for execution of the above work (including general & special electrodes) will have to be supplied by the Contractor.
18. INPUTS BY BPSCL (Free of Cost)
 - a) All the spares of the machine including supply of special screws & fasteners etc.
 - b) All the special T& P as provided by manufacturer. Load test certificates by the competent authority will be provided by BPSCL.
 - c) Stator wedges, under wedge packers, materials required for re-braiding.
 - d) All scaffolding materials like sleepers, wooden planks, pipes etc and fabrication fixture materials like steel channel, angles & plates etc. as required at site for the job.
 - e) Availability of EOT cranes in operating condition. For the crane, load test certificates by the competent authority will be provide by BPSCL.
 - f) Workshop facility.
 - g) Truck/Crane/Hydra as & when required for in plant transportation of turbine internals for machining at different workshop.
 - h) Adequate lightening, low pressure air supply points, power supply points and water supply points nearby the working area.

19. TO BE PROVIDED BY THE CONTRACTOR.

- a) All consumables, special or ordinary like Molykote, Hylomer, Stag – B, Silicone sealants, Rustolene, Different type of gasket, SS shim, Metallic and Nonmetallic gland packing, All Rubber Parts, Coupling bushes etc. as required for commissioning.
- b) All necessary equipment including air compressor and accessories for alumina blasting for cleaning of rotor and internals. The equipment including the high pressure piping, air compressor, consumable items required for alumina blasting are to be arranged by the contractor. The material required for erecting the tents will be arranged by the Contractor.
- c) Induction heating equipment for bolt heating during casing opening & again during assembly.
- d) All electrodes for welding. In case of special purpose, electrodes for critical jobs (*it should have consent of Engineer in – charge as well as supported by the documentary certificate of O.E.M.*)
- e) E.O.T. crane operators
- f) All tools and tackles, safety items for work men.
- g) All N.D.T. kits, consumables and personnel.
- h) Special Consumables for generator like silicon rubber cord of different sizes and required quantity, rubber sheet, dendrite, Cork sheet and all other consumable.
- i) All instruments, consumables and other accessories required to carry out the job for electrical testing of generator.
- j) All materials, consumables and equipments required for insulation and spray paintings.
- k) All scaffolding materials like sleepers, wooden planks, pipes etc. and fabrication fixture materials like steel channel, angles & plates etc.

3. Following Reports shall be submitted by Contractor:

- a) Evaluation of present condition & operation data.
- b) Recommendation to run/ repair/ replace for T.G. Components. Recommendation for R&M for the unit for betterment and capacity enhancement.
- c) All the collected technical data of equipment/ components.
- d) Comparative graph/ details for present and rated values/ parameters.
- e) All test reports (NDT, visual or any destructive) as per standards clearly correlating components and its exact location.
- f) Various data collected for equipment in running condition and in dissembled condition.
- g) Chemical analysis of all the varieties of scales, deposits collected.
- h) Report for recommendations regarding items to be replaced immediately, within 03 years or within 06 years. For this, Contractor shall have supporting reports and photographs Root cause analysis reports etc. Preliminary report should be submitted immediately.
- i) All the above in hard and soft copy format in 03 sets.
- j) Final comprehensive report in 03 copies (hard copy) & 1 soft copy within 03 month after work completion.

4. **LD Clause:** In case of delay in completion beyond completion period (*i.e. 35 days from the date of issue of work permit*), for the reasons attributable to the contractor, BPSCL reserves the right to recover from the contractor a sum equivalent to 2% of the value of the delayed materials/work/equipment/spares for each week of delay and part thereof subject to maximum of 10% of the total value or the contract as Liquidated Damage (LD).

5. **PENALTY CLAUSES:**

Sl. No.	Description of Violation	Amount Per Violation
1.	If job is not started within 28 days of intimation.	Rs. 5,000.00 per day of delay .