1.00.00	**GENERAL**
1.01.00	The following provisions shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work or this contract to be performed at site. The erection requirements and procedures not specified in these documents shall be in accordance with the recommendations of the equipment manufacturer, or as mutually agreed to between the Employer and the Contractor prior to commencement of erection work.
1.02.00	The Contractor upon signing of the Contract shall, in addition to a Project Co-ordinator, nominate another responsible officer as his representative at Site suitably designated for the purpose of overall responsibility and co-ordination of the Works to be performed at Site. Such person shall function from the Site office of the Contractor during the pendency of Contract.
2.00.00	**REGULATION OF LOCAL AUTHORITIES AND STATUTES**
2.01.00	In addition to the local laws and regulations the Contractor shall also comply with the Minimum Wages Act and the Payment of Wages Act (both of the Government of India) and the rules made there under in respect of its labour and the labour of its sub-contractors currently employed on or connected with the contract.
2.02.00	All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the Indian Boiler Regulations and any other statutory laws and its amendments from time to time during erection in respect of the plant equipment ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees to such inspection and/or registration shall be borne by the Contractor.
3.00.00	**WELDING OF PRESSURE PARTS AND HIGH PRESSURE PIPING** The welding of all pressure parts and high pressure piping shall be in accordance with the following requirements:
3.01.00	**Qualification of Weld Procedures** All the welding procedures adopted by the Contractor shall be qualified in accordance with the latest applicable requirements of Section IX of ASME code before the work is begun. The Contractor shall submit to the Employer for review, copies of certificates qualifying welding procedures proposed to be used. Such certified welding procedures for welding of pressure parts and pipings submitted to the Employer shall clearly state the type of material, material thickness, the joint details, the pre-heat temperature maintained, the post weld heat treatment given and the welding current and the voltage used during qualifications of welding procedures.
3.02.00	**Welder's Qualification** Only welders, qualified in accordance with the latest applicable requirements of the Indian Boiler Regulations, shall be permitted to perform any welding work on the pressure parts. In addition to such statutory qualification requirements, the welders

shall also perform a satisfactory pre-production qualification test to be conducted by the Contractor at site in consultation with and to the requirements of the Employer, prior to performing work under these specifications. The services of an independent testing laboratory shall be retained by the Contractor to perform welder qualification tests for welders.

All the welders carrying out welding at site, shall carry an identification badge, which shall indicate the category and the grade of welding for which they have been tested and authorised to carry out welding. All such badges shall be countersigned by the Employer.

3.03.00 **Records**

All records of the welding procedures, the welder's qualification tests and the welders' performance details for the work performed under these specifications shall be maintained by the Contractor in a manner acceptable to the Employer. The certified copies of any or all the above documents shall be submitted to the Employer on request.

3.04.00 **Marking**

On completion of each welded joint, the welder shall mark his regularly assigned identification mark near the joint. The welder's identification numbers, inspection stamps or code symbol stamps and any other information shall not be directly stamped on any alloy steel piping. In alloy steel piping, all such information shall be stamped on separate marking plate which shall be tack welded on pipe near the weld.

4.00.00 HEAT TREATMENT

4.01.00 Pre-heating, post-heating and post - weld stress relief operations of all welds, shall be performed in accordance with the requirements of applicable code. Local postweld stress relieving heat - treatments shall be adopted only in cases where it is normally impracticable to subject the entire assembly as such for stress relieving operations. Heating may be by means of electric induction coils or electric resistance coils. Oxy-acetylene flame heating or exothermic chemical heating methods will not be permitted. Complete recording of the temperatures through out the stress relieving cycle of the material and the weld subjected to heat treatment shall be made by means of a potentiometric recorder. Recorders other than those of potentiometric type shall not be used for such temperature recording during stress relieving operations.

4.02.00 After setting up the weld joint for heat treatment operation, the Employer's signature shall be obtained on the strips chart of the recorder prior to starting of heat treatment cycle. The right hand corner of the strip chart at the starting point of the heat treatment cycle shall contain details like the weld number, material, diameter and thickness, method of heating adopted, prescribed ranges of heat treatment temperatures, date of heat treatment, reference to item number of the Field welding Schedule (Clause 7.00.00 of this Part) etc.

5.00.00 WELD EDGE PREPARATION

Preparation at site of weld joint shall be in accordance with details acceptable to the Employer. Wherever possible, machining or automatic flame cutting shall be used for edge preparation. Hand flame cutting will be permitted only where edge preparation otherwise is impractical. All slag shall be removed from cuts and all the hand cuts shall be ground smooth to the satisfaction of the Employer. Flame cutting of alloy steel pipe shall be avoided. Wherever such cutting is done, a 200 mm length at the cut face shall be removed by machining. Pneumatic hand tools such as edge preparation, tube cutting machine can be used.

6.00.00 CLEANING AND SERVICING

6.01.00 The inside of all tubes, pipes, valves and fittings shall be free from dirt and loose scales before being erected. All the pipe lines shall be thoroughly blown and/or flushed. Each steam and water tubes shall be blown with compressed air and shall be subjected to 'ball test' before erection to ensure that no obstructions exist. A system for recording of all such operations shall be developed and maintained in a manner to ensure that no obstructions are left inside the tubes and no tubes are left uncleaned and untested.

6.02.00 All valves and valve actuators, and dampers and damper actuators, if any, shall be thoroughly cleaned and service prior to pre-commissioning tests and/or Initial Operations of the plant. A system for recording of such servicing operation shall be developed and maintained in a manner acceptable to the Employer and to ensure that no valves or dampers including their actuators are left unserviced.

6.03.00 All interior surfaces of the turbine shall be thoroughly cleaned prior to boxing - up to remove all traces of oil preservations.

7.00.00 FIELD WELDING SCHEDULE

The Contractor shall submit to the Employer, a certified and complete field welding schedule for all the field welding activities to be carried out in respect of the pressure parts involved in the equipment furnished and erected by him, at least 90 days prior to the scheduled start of erection work at site. Such schedule will be strictly followed by the Contractor during the process of erection. The above field welding schedule to be issued by the Contractor shall contain the following:

a) Drawing No (s)

b) Location of the weld

c) Size of the weld (outside diameter and thickness)

d) Type of joints

e) Material specifications

f) Size of fillet on backing ring, when the type of joint is with backing ring

g) Electrode/ filler metal specifications

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	h)	Number of welds per unit
	i)	Quantity of filler metal per weld
	j)	Indication of required Non-destructive Examination (NDE) for each weld
	k)	Pre-heat temperatures for welding
	l)	Process of welding
	m)	Post-welding heat treatment temperature ranges, duration, under clause 3.01.00 entitled 'Qualification of Weld Procedures' in this Part-D.
	n)	Qualification details of weld procedures to be adopted as specified under clause 3.01.00 entitled ' Qualification of Weld Procedures' in this Part-D.

8.00.00 SITE RUN MISCELLANEOUS PIPING

Sketches or diagrams of the proposed routings of all piping, not already indicated and routed on the shop drawings which were reviewed by the Employer, shall be submitted to the Employer for review, Employer's acceptance of the site routings shall be obtained before the piping is erected. All these site run piping shall be installed in such a manner as to present an orderly and neat installation. They shall be located as to avoid obstruction of access and passages. Valves, instruments or any other special items shall be located convenient for operation by the operating personnel. Pipe runs shall be plumb or level except where pitch for drainage is required. Pipe runs that are not parallel to the building structure, walls or column rows shall be avoided so that deflection of pipe between hangers does not exceed 6 mm. No miscellaneous pipe shall be routed and installed above or adjacent to electrical equipment.

9.00.00 THERMAL EXPANSIONS

All piping installation shall be such that no excessive or destructive expansion forces exist either in the cold condition or under condition of maximum temperature. All bends, expansion joints and any other special fittings, necessary to provide proper expansion, shall be incorporated. During installation of expansion joints and anchors, care must be taken to make sure that full design movement is available at all times for maximum to minimum temperature and vice-versa.

10.00.00 PIPING SUPPORTS

10.01.00 Hangers, supports and anchors shall be installed as required to obtain a safe, reliable and complete pipe installation. All supports shall be properly leveled and anchored when installed. The anchors shall be so placed that thermal expansion will be absorbed by bends without subjecting the valves or equipment to excessive strains.

10.02.00 The hanger assemblies shall not be used for the attachment of rigging to hoist the pipe into place. Other means shall be used to securely hold the pipe in place till the pipe support is completely assembled and attached to the pipe and building structures and spring support is set to accommodate the pipe way. All temporary rigging shall be removed in such a way that the pipe support is not subjected to any

sudden load. All piping, having variable spring type supports, shall be held securely in place by temporary means during the hydraulic test of pipe system. Constant support type spring hangers used during hydraulic test shall be pinned or blocked solid during the test. After complete installation and insulation of the piping and filling of the piping with its normal operating medium, the pipe support springs shall be adjusted to the cold positions. If necessary, the spring support shall be re-adjusted to the hot positions after the line has been placed for service at its normal maximum operating temperature conditions. Electric arc welding only shall be used to weld all pipe supports to structural steel members that form part of the building supporting structure. The structural beams shall not be heated more than necessary during welding of supports and such welds shall run parallel to the axis of the span. All lugs or any other attachments welded to the piping shall be of the same material as the pipe.

11.00.00 CODE REQUIREMENTS

The erection requirements and procedures to be followed during the installation of the equipment shall be in accordance with the relevant Indian Electricity Rules Codes, Indian Boiler Regulations, ASME codes and accepted good practice, the Employer Drawings and other applicable Indian recognized codes and laws and regulations of the Government of India.

12.00.00 REMOVAL OF MATERIAL

No material brought to the Site shall be removed from the Site by the Contractor and/or his Sub-Contractors without the prior written approval of the Employer.

13.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

The provisions of the clause entitled Inspection, Testing and Inspection Certificates given in Part - C of the Technical Specification, shall also be applicable to the erection portion of the Works. The Employer shall have the right to re-inspect any equipment though previously inspected and approved by him at the Contractor's works, before and after the same are erected at Site. If by the above inspection, the Employer rejects any equipment, the Contractor shall make good for such rejections either by replacement or modification/ repairs as may be necessary to the satisfaction of the Employer. Such replacements will also include the replacements or re-execution of such of those works of other Contractors and/or agencies, which might have got damaged or affected by the replacements or re-work done to the Contractor's work.

14.00.00 ACCESS TO SITE AND WORKS ON SITE

14.01.00 Suitable access to site and possession of the Site shall be afforded to the Contractor by the Employer in reasonable time.

14.02.00 In the execution of the Works, no person other than the Contractor or his duly appointed representative, Sub-Contractor and workmen, shall be allowed to do work on the Site, except by the special permission, in writing by the Employer or his representative.

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15.00.00	**CONTRACTOR'S SITE OFFICE ESTABLISHMENT**
	The Contractor shall establish a Office at the Site and keep posted an authorised representative for the purpose of the Contract. Any written order or instruction of the Employer or his duly authorised representative shall be communicated to the said authorised resident representative of the Contractor and the same shall be deemed to have been communicated to the Contractor at his legal address.
16.00.00	**CO-OPERATION WITH OTHER CONTRACTORS**
16.01.00	The Contractor shall co-operate with all other Contractors or tradesmen of the Employer, who may be performing other works on behalf of the Employer and the workmen who may be employed by the Employer and doing work in the vicinity of the Works under the Contract. The Contractor shall also arrange to perform his work as to minimize, to the maximum extent possible, interference with the work of other Contracts and their workmen. Any injury or damage that may be sustained by the employees of the other Contractors and the Employer, due to the Contractor's work shall promptly be made good at his own expense. The Employer shall determine the resolution of any difference or conflict that may arise between the Contractor and other Contractors or between the Contractor and the workmen of the Employer in regard to their work. If the work of the Contractor is delayed because of the any acts of omission of another Contractor, the Contractor shall have no claim against the Employer on that account other than an extension of time for completing his Works. Employer shall give full access to visit the contractor's site at any time for inspection & surveillance checks.
16.02.00	The Employer shall be notified promptly by the Contractor of any defects in the other Contractor's works that could affect the Contractor's Works. The Employer shall determine the corrective measures if any, required to rectify this situation after inspection of the works and such decisions by the Employer shall be binding on the Contractor.
17.00.00	**DISCIPLINE OF WORKMEN**
	The Contractor shall adhere to the disciplinary procedure set by the Employer in respect of his employees and workmen at Site. The Employer shall be at liberty to object to the presence of any representative of employee of the Contractor at the Site, if in the opinion of the Employer such employee has mis-conducted himself or incompetent or negligent or otherwise undesirable then the Contractor shall remove such a person objected to and provide in his place a competent replacement.
18.00.00	**CONTRACTOR'S FIELD OPERATION**
18.01.00	The Contractor shall keep the Employer informed in advance regarding his field activity plans and schedules for carrying out each part of the works. Any review of such plan or schedule or method of work by the Employer shall not relieve the Contractor of any of responsibilities towards the field activities. Such reviews shall also not be considered as an assumption of any risk or liability by the or the Employer or any of his representatives and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.

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18.02.00	The Contractor shall have the complete responsibility for the conditions of the Work-Site including the safety of all person employed by him or his Sub-Contractor and all the properties under his custody during the performance of the work. This requirement shall apply continuously till the completion of the Contract and shall not be limited to normal working hours. The construction review by the Employer is not intended to include review of Contractor's safety measures in, on or near the Work-Site, and their adequacy or otherwise.
19.00.00	**PHOTOGRAPHS AND PROGRESS REPORT**
19.01.00	The Contractor shall furnish three (3) prints each to the Employer of progress photographs of the work done at Site. Photographs shall be taken as and when indicated by the Employer or his representative. Photographs shall be adequate in size and number to indicate various stages of erection. Each photograph shall contain the date, the name of the Contractor and the title of the photograph.
19.02.00	The above photographs shall accompany the monthly progress report detailing out the progress achieved on all erection activities as compared to the schedules. The report shall also indicate the reasons for the variance between the scheduled and actual progress and the action proposed for corrective measures, wherever necessary.
19.03.00	The Contractor shall submit the progress of work in video cassettes (2 copies) quarterly highlighting the progress and constraints at site.
20.00.00	**MAN-POWER REPORT**
20.01.00	The Contractor shall submit to the Employer, on the first day of every month, a man hour schedule for the month, detailing the man hours scheduled for the month, skill-wise and area-wise.
20.02.00	The Contractor shall also submit to the Employer on the first day of every month, a man power report of the previous month detailing the number of persons scheduled to have been employed and actually employed, skill-wise and the areas of employment of such labour.
21.00.00	**PROTECTION OF WORK**
	The Contractor shall have total responsibility for protecting his works till it is finally taken over by the Employer. No claim will be entertained by the Employer or the Employer for any damage or loss to the Contractor's works and the Contractor shall be responsible for complete restoration of the damaged works to original conditions to comply with the specification and drawings. Should any such damage to the Contractor's Works occur because or other party not being under his supervision or control, the Contractor shall make his claim directly with the party concerned. If disagreement or conflict or dispute develops between the Contractor and the other party or parties concerned regarding the responsibility for damage to the Contractor's Works the same shall be resolved as per the provisions of the Clause 16.00.00 above entitled "Co-operation with other Contractors." The Contractor shall not cause any delay in the repair of such damaged Works because of any delay in the resolution of such disputes. The Contractor shall proceed to repair the Work immediately and no cause thereof will be assigned pending resolution of such disputes.

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22.00.00	**EMPLOYMENT OF LABOUR**
22.01.00	In addition to all local laws and regulations pertaining to the employment of labour to be complied by the Contractor pursuant to GCC, the Contractor will be expected to employ on the work only his regular skilled employees with experience of his particular work. No female labour shall be employed after darkness. No person below the age of eighteen years shall be employed.
22.02.00	All travelling expenses including provisions of all necessary transport to and from Site, lodging allowances and other payments to the Contractor's employees shall be the sole responsibility of the Contractor.
22.03.00	The hours of work on the Site shall be decided by the Employer and the Contractor shall adhere to it. Working hours will normally be eight (8) hours per day - Monday through Saturday.
22.04.00	Contractor's employees shall wear identification badges while on work at Site.
22.05.00	In case the Employer becomes liable to pay any wages or dues to the labour or any Government agency under any of the provisions of the Minimum Wages Act, Workmen Compensation Act, Contract Labour Regulation Abolition Act or any other law due to act of omission of the Contractor, the Employer may make such payments and shall recover the same from the Contractor's Bills.
23.00.00	**FACILITIES TO BE PROVIDED BY THE EMPLOYER**
23.01.00	**Communication:**
	The employer will extend the telephone facilities, if available at site, for purpose of contract. The Contractor shall be charged at actuals for such facilities.
23.02.00	**Cranes**
23.02.01	One (1) number of EOT crane in the Power House and one (1) number of EOT Crane in Butterfly Valve House to be procured under this package shall be used by the Contractor for erection of the equipment. For equipments which cannot be handled by these cranes, the Contractor shall make his own arrangements.
23.02.02	Contractors shall clearly bring out in his offer the proposed method of installation of hydro turbine generator equipments. This shall be supported by detailed write up drawings & other technical data.
24.00.00	**FACILITIES TO BE PROVIDED BY THE CONTRACTOR**
24.01.00	The Contractor shall make his own arrangements for suitable and adequate land /space & power supply for his office, storage area, pre-assembly and fabrication areas, labour and staff colony area, toilets etc. at a convenient place near the project area. Adequate and suitable security arrangements including lighting to be provided by the Contractor for the storage area & pre-assembly and fabrication areas shall be subject to approval of the Employer. The above arrangement shall be at no extra cost to the employer.

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24.02.00	**Construction Power Supply** The Contractor shall make his own arrangement for construction power. Contractor shall arrange DG sets of adequate capacity at his own cost to meet construction power supply requirement including lighting, dewatering etc. The Contractor shall submit to the Employer within thirty (30) days from the date of acceptance of the Notification of Award, his electrical power requirements and mobilization plan for the same. All wiring must comply with local regulations and will be subject to Employer inspection and approval before connection to supply.
24.03.00	**Power Supply and Illumination to be arranged by the Contractor**
24.03.01	The Contractor shall install, operate and maintain electrical distribution system which shall include transformers, circuit breakers, disconnection and safety switches, voltage regulators, lines, poles, pole hardware, conductors, meters and other equipments as required for power distribution throughout his site and temporary facilities.
24.03.02	The Contractor shall ensure adequate illumination as required for his work area.
24.04.00	**Water** Contractor shall make all arrangements himself for the supply of construction water as well as potable water for labour and other personnel at the worksite /colony.
24.05.00	**Contractor's site office Establishment** The Contractor shall establish a site office at the site and keep posted an authorized representative for the purpose of the contract, pursuant to GCC.
24.06.00	**Tools, tackles and scaffoldings** The Contractor shall provide all the construction equipments, tools, tackles and scaffoldings required for pre-assembly, erection, testing and commissioning of the equipments covered under the Contract. He shall submit a list of all such materials to the Employer before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Employer. The Contractor shall arrange Dozer, Hydra, Cranes, Trailor, etc. for the purpose of fabrication, erection and commissioning.
24.07.00	**First-aid**
24.07.01	The Contractor shall provide necessary first-aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Contractor's personnel shall be trained in administering first-aid.
24.08.00	**Cleanliness**
24.08.01	The Contractor shall be responsible for keeping the entire area allotted to him clean and free from rubbish, debris etc. during the period of Contract. The Contractor shall employ enough number of special personnel to thoroughly clean his work-area at least once in a day. All such rubbish and scrap material shall be stacked or disposed

	in a place to be identified by the Employer. Materials and stores shall be so arranged to permit easy cleaning of the area. In areas where equipment might drip oil and cause damage to the floor surface, a suitable protective cover of a flame resistant, oil proof sheet shall be provided to protect the floor from such damage.
24.08.02	Similarly the labour colony, the offices and the residential areas of the Contractor's employees and workmen shall be kept clean and neat to the entire satisfaction of the Employer. Proper sanitary arrangements shall be provided by the Contractor, in the work-areas, office and residential areas of the Contractor.
25.00.00	**LINES AND GRADES**
	All the Works shall be performed to the lines, grades and elevations indicated on the drawings. The Contractor shall be responsible to locate and layout the Works. Basic horizontal and vertical control points will be established and marked by the Employer at Site at suitable points. These points shall be used as datum for the works under the Contract. The Contractor shall inform the Employer well in advance of the times and places at which he wishes to do work in the area allotted to him so that suitable datum points may be established and checked by the Employer to enable the Contractor to proceed with his works. Any work done without being properly located may be removed and/or dismantled by the Employer at Contractor's expense.
26.00.00	**FIRE PROTECTION**
26.01.00	The work procedures that are to be used during the erection shall be those which minimise fire hazards to the extent practicable. Combustible materials, combustible waste and rubbish shall be collected and removed from the Site at least once each day. Fuels, oils and volatile or flammable materials shall be stored away from the construction and equipment and materials storage areas in safe containers. Untreated canvas, paper, plastic or other flammable flexible materials shall not at all be used at Site for any other purpose unless otherwise specified. If any such materials are received with the equipment at the Site, the same shall be removed and replaced with acceptable material before moving into the construction or storage area.
26.02.00	Similarly corrugated paper fabricated cartons etc. will not be permitted in the construction area either for storage or for handling of materials. All such materials used shall be of water proof and flame resistant type. All the other materials such as working drawings, plans etc. which are combustible but are essential for the works to be executed shall be protected against combustion resulting from welding sparks, cutting flames and other similar fire sources.
26.03.00	All the Contractor's supervisory personnel and sufficient number of workers shall be trained for fire-fighting and shall be assigned specific fire protection duties. Enough of such trained personnel must be available at the Site during the entire period of the Contract.
26.04.00	The Contractor shall provide enough fire protection equipment of the types and number for the warehouses, office, temporary structures, labour colony area etc. Access to such fire protection equipment, shall be easy and kept open at all time.

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27.00.00 **SECURITY**

The Contractor shall have total responsibility for all equipment and materials in his custody stores, loose, semi-assembled and/or erected by him at Site. The Contractor shall make suitable security arrangements including employment of security personnel to ensure the protection of all materials, equipment and works from theft, fire, pilferage and any other damages and loss. All materials of the Contractor shall enter and leave the Employer Site only with the written permission of the Employer in the prescribed manner.

28.00.00 **CONTRACTOR'S AREA LIMITS**

The Employer will mark-out the boundary limits of access roads, parking spaces, storage and construction areas for the Contractor and the Contractor shall not trespass the areas not so marked out for him. The Contractor shall be responsible to ensure that none of his personnel move out of the areas marked out for his operations. In case of such a need for the Contactor's personnel to work out of the areas marked out for him the same shall be done only with the written permission of the Employer.

29.00.00 **CONTRACTOR'S CO-OPERATION WITH THE EMPLOYER**

In case where the performance of the erection work by the Contractor affects the operation of the system facilities of the Employer, such erection work of the Contractor shall be scheduled to be performed only in the manner stipulated by the Employer and the same shall be acceptable at all times to the Contractor. The Employer may impose such restrictions on the facilities provided to the Contractor such as electricity, etc. as he may think fit in the interest of the Employer and the Contractor shall strictly adhere to such restrictions and co-operate with the Employer. It will be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are erected by him. The Contractor shall also be responsible for flushing and initial filling of all the oil and lubricants required for the equipment furnished and erected by him, so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in documents and specifications.

30.00.00 **PRE-COMMISSIONING ACTIVITIES, COMMISSIONING OF FACILITIES AND INITIAL OPERATIONS**

30.01.00 **General**

30.01.01 The pre-commissioning and commissioning activities including tests, checks and initial operations of the equipment furnished and erected by the Contractor shall be the responsibility of the Contractor as detailed in relevant clauses in Technical Specification. The Contractor shall provide, in addition, test instruments, calibrating devices, etc. and labour required for successful performance of these operations. If it is anticipated that the above test may prolong for a long time, the Contractor's workmen required for the above test shall always be present at Site during such operations.

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30.01.02	It shall be the responsibility of the Contractor to provide all necessary temporary instrumentation and other measuring devices required during start-up and operation of the equipment systems which are installed by him. The Contractor shall also be responsible for flushing & initial filling of all oils & lubricants required for the equipment furnished and installed by him so as to make such equipment ready for operation. The Contractor shall be responsible for supplying such flushing oil and other lubricants unless otherwise specified elsewhere in these specifications & documents.
30.01.03	The Contractor upon completion of erection of equipments and systems, shall conduct pre-commissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation. All pre-commissioning/ commissioning activities considered essential for such readiness of the facilities including those mutually agreed and included in the Contractors quality assurance programme as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Contractor.
30.02.00	**Testing / Commissioning Schedule** The Contractor shall submit to the Employer, his testing/ commissioning schedules for various equipments/ systems covered under the contract, for approval, at least 18 months before the actual commissioning of the equipment/ systems. The testing/ commissioning schedule is required to be of a standard format in order to maintain consistency of presentation, content and reporting. The list of documents and commissioning checks to be submitted and their content details shall be agreed upon during preaward discussions.
30.03.00	**Pre-Commissioning Activities**
30.03.01	**General** The Contractor shall draw up a detailed sequential & systematic list of checks/ tests and various activities/ procedures connected with pre-commissioning of the complete facilities with all systems, sub-systems and equipment supplied and installed by him and get the same approved by the Employer.
30.04.00	**Commissioning of Facilities**
30.04.01	**General** Upon completion of pre-commissioning activities/test the Contractor shall initiate commissioning of facilities. During commissioning the Contractor shall carryout system checking and reliability trials on various parts of the facilities. Contractor shall carry out these checks/tests at site to prove to the Employer that each equipment of the supply complies with requirements stipulated and is erected in accordance with requirements specified. Before the plant is put into initial operation the Contractor shall be required to conduct test to demonstrate to the Employer that each item of the plant is capable of correctly performing the functions for which it was specified and its performance, parameters etc. are as per the specified/approved values. These tests may be conducted concurrently with those required under commissioning sequence.

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30.04.02	**Initial Operation** Upon completion of system checking/tests as per 30.04.01 above and as a part of commissioning of facilities, complete plant/facilities shall be put on initial operation for a period of thirty (30) days or 720 hours as stipulated in General Technical Requirements.
31.00.00	**MATERIALS HANDLING AND STORAGE**
31.01.00	All the equipments furnished under the Contract and arriving at Site shall be promptly received, unloaded and transported and stored in the storage spaces by the Contractor.
31.02.00	Contractor shall be responsible for examining all the shipment and notify the Employer immediately of any damage, shortage, discrepancy etc. for the purpose of Employer's information only. The Contractor shall submit to the Employer every week a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damage in transit, handling and / or in storage and erection of the equipment at Site. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
31.03.00	The Contractor shall maintain an accurate and exhaustive record detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the Employer.
31.04.00	All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings, etc. shall be used for unloading and/or handling of the equipment without the specific written permission of the Employer. The equipment stored shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the store shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at Site.
31.05.00	All electrical panels, controls gear, motors and such other devices shall be properly dried by heating before they are installed and energized. Motor bearings, slip rings, commutators and other exposed parts shall be protected against moisture ingress and corrosion during storage and periodically inspected. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion due to prolonged storage.
31.06.00	All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months from the date of receipt till the date of commissioning and a record of such measured insulation values maintained by the Contractor. Such records shall be open for inspection by the Employer.
31.07.00	The Contractor shall ensure that all the packing materials and protection devices used for the various equipments during transit and storage are removed before the equipment are installed.
31.08.00	The consumables and other supplies likely to deteriorate due to storage must be thoroughly protected and stored in a suitable manner to prevent damage or deterioration in quality by storage.

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31.09.00	All the materials stored in the open or dusty location must be covered with suitable weather-proof and flameproof covering material wherever applicable.
31.10.00	If the materials belonging to the Contractor are stored in areas other than those earmarked for him, the Employer will have the right to get it moved to the area earmarked for the Contractor at the Contractor's cost.
31.11.00	The Contractor shall be responsible for making suitable indoor storage facilities to store all equipment which require indoor storage. Normally, all the electrical equipments such as motors, control gear, generators, exciters and consumables like electrodes, lubricants etc. shall be stored in the closed storage space. The Employer, in addition, may direct the Contractor to move certain other materials, which in his opinion will require indoor storage, to indoor storage areas which the Contractor shall strictly comply with.
32.00.00	**CONSTRUCTION MANAGEMENT**
32.01.00	The field activities of the Contractors working at Site, will be coordinated by the Employer and the Employer decision shall be final in resolving any disputes or conflicts between the Contractor and other Contractors and tradesmen of the Employer regarding scheduling and co- ordination of work. Such decision by the Employer shall not be a cause for extra compensation or extension of time for the Contractor.
32.02.00	The Employer shall hold weekly meetings of all the Contractors working at Site, at a time and place to be designated by the Employer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Employer and shall strictly adhere to those decisions in performing his Works. In addition to the above weekly meeting, the Employer may call for other meeting either with individual Contractors or with selected number of Contractors and in such a case the Contractor if called, will also attend such meetings.
32.03.00	**Time is the essence of the Contract** and the Contractor shall be responsible for performance of his works in accordance with the specified construction schedule. If at any time, the Contractor is falling behind the schedule, he shall take necessary action to make good for such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such actions in writing to the Employer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.
32.04.00	The Employer shall however not be responsible for provision of additional labour and/or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.
33.00.00	**FIELD OFFICE RECORDS**
	The Contractor shall maintain at his Site Office up-to-date copies of all drawings, specifications and other Contract Documents and any other supplementary data complete with all the latest revisions thereto. The Contractor shall also maintain in addition the continuous record of all changes to the above Contract Documents, drawings, specifications, supplementary data, etc. effected at the field and on completion of his total assignment under the Contract shall incorporate all such

changes on the drawings and other Engineering data to indicate as installed conditions of the equipment furnished and erected under the Contract. Such drawings and Engineering data shall be submitted to the Employer in required number of copies.

34.00.00 CONTRACTOR'S MATERIALS BROUGHT ON TO SITE

34.01.00 The Contractor shall bring to Site all equipment, components, parts, materials, including construction equipment, tools and tackles for the purpose of the Works under intimation to the Employer. All such goods shall, from the time of their being brought vest in the Employer, but may be used for the purpose of the Works only and shall not on any account be removed or taken away by the Contractor without the written permission of the Employer. The Contractor shall nevertheless be solely liable and responsible for any loss or destruction thereof and damage thereto.

34.02.00 The Employer shall have a lien on such goods for any sum or sums which may at any time be due or owing to him by the Contractor, under, in respect of or by reasons of the Contract. After giving a fifteen (15) days notice in writing of his intention to do so, the Employer shall be at liberty to sell and dispose off any such goods, in such manner as he shall think fit including public auction or private treaty and to apply the proceeds in or towards the satisfaction of such sum or sums due as aforesaid.

34.03.00 After the completion of the Works, the Contractor shall remove from the Site under the direction of the Employer the materials such as construction equipment, erection tools and tackles, scaffolding etc. with the written permission of the Employer. If the Contractor fails to remove such materials, within fifteen (15) days of issue of a notice by the Employer to do so then the Employer shall have the liberty to dispose off such materials as detailed under clause 34.02.00 above and credit the proceeds thereto to the account of the Contractor.

35.00.00 PROTECTION OF PROPERTY AND CONTRACTOR'S LIABILITY

35.01.00 The Contractor shall be responsible for any damage resulting from his operations. He shall also be responsible for protection of all persons including members of public and employees of the Employer and the employees of other Contractors and Sub- Contractors and all public and private property including structures, building, other plants and equipments and utilities either above or below the ground.

35.02.00 The Contractor will ensure provision of necessary safety equipment such as barriers, sign-boards, warning lights and alarms, etc. to provide adequate protection to persons and property. The Contractor shall be responsible to give reasonable notice to the Employer and the Employers of public or private property and utilities when such property and utilities are likely to get damaged or injured during the performance of his Works and shall make all necessary arrangements with such Employers, related to removal and/or replacement or protection of such property and utilities.

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36.00.00 INSURANCE

36.01.00 In addition to the conditions covered under the Clause entitled "Insurance" in Section General Conditions of Contract (GCC), the following provisions will also apply to the portion of works to be done beyond the Contractor's own or his Sub-Contractor's manufacturing Works.

36.02.00 **Workmen's Compensation Insurance**

This insurance shall protect the Contractor against all claims applicable under the Workmen's Compensation Act, 1948 (Government of India). This policy shall also cover the Contractor against claims for injury, disability disease or death of his or his Sub-Contractor's employees, which for any reason are not covered under the Workmen's Compensation Act, 1948. The liabilities shall not be less than:

Workmen's Compensation	:	As per statutory Provisions
Employee's liability.	:	As per statutory Provisions

36.03.00 **Comprehensive Automobile Insurance**

This insurance shall be in such a form to protect the Contractor against all claims for injuries, disability, disease and death to members of public including the Employer's men and damage to the property of other arising from the use of motor vehicles during on or off the Site operations, irrespective of the Ownership of such vehicles. The liability covered shall be as herein indicated:

Fatal Injury	:	Rs.100,000 each person
	:	Rs.200,000 each occurrence
Property Damage	:	Rs.100,000 each occurrence

36.04.00 **Comprehensive General Liability Insurance**

36.04.01 The insurance shall protect the Contractor against all claims arising from injuries, disabilities, disease or death of members of public or damage to property of others, due to any act or omission on the part of the Contractor, his agents, his employees, his representatives and Sub-Contractors or from riots, strikes and civil commotion. This insurance shall also cover all the liabilities of the Contractor arising out of the Clause entitled "Defence of Suits" in Section General Conditions of Contract (GCC).

36.04.02 The hazards to be covered will pertain to all the Works and areas where the Contractor, his Sub-Contractors, his agents and his employees have to perform work pursuant to the Contract.

36.05.00 The above are only illustrative list of insurance covers normally required and it will be the responsibility of the Contractor to maintain all necessary insurance coverage to the extent both in time and amount to take care of all his liabilities either direct or indirect, in pursuance of the Contract.

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37.00.00 UNFAVOURABLE WORKING CONDITIONS

The Contractor shall confine all his field operations to those works which can be performed without subjecting the equipment and materials to adverse effects during inclement weather conditions, like monsoon, storms, etc. and during other unfavourable construction conditions. No field activities shall be performed by the Contractor under conditions which might adversely affect the quality and efficiency thereof, unless special precautions or measures are taken by the Contractor in a proper and satisfactory manner in the performance of such Works and with the concurrence of the Employer. Such unfavourable construction conditions will in no way relieve the Contractor of his responsibility to perform the Works as per the schedule.

38.00.00 PROTECTION OF MONUMENTS AND REFERENCE POINTS

The Contractor shall ensure that any finds such as relic, antiquity, coins, fossils, etc. which he may come across during the course of performance of his Works either during excavation or elsewhere, are properly protected and handed over to the Employer. Similarly the Contractor shall ensure that the bench marks, reference points, etc., which are marked either with the help of Employer or by the Employer shall not be disturbed in any way during the performance of his Works. If, any work is to be preformed which disturb such reference, the same shall be done only after these are transferred to other suitable locations under the direction of the Employer. The Contractor shall provide all necessary materials and assistance for such relocation of reference points etc.

39.00.00 WORK & SAFETY REGULATIONS

39.01.00 **General**

i) The contractor shall comply with all the equipments of "The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act," 1996 and its Central Rule 1998 / State Rules and any other statutory requirements as applicable.

ii) The contractor shall follow the Employer's Safety Rules as issued from time to time with respect to safety in construction & erection.

iii) The contractor shall have the approved Safety, Health and Environment (SHE) Policy in respect of Safety and health of Building Workers and it shall be circulated widely and displayed at conspicuous place in Hindi and local language understood by the majority of the workers. A copy of the safety policy should be submitted to the Project Manager.

iv) The contractor shall submit the safety plan comprising of methods to implement the safety policy/rules, risk assessment and ensuring Safety at work areas, Safety audits, inspections and its compliance, supervision and responsibility to ensure safety at various levels, safety training to employees, review of safety and accident analysis, ensure health and safety procedures to prevent accidents to the Project Manager for approval as per the format of Safety Plan as annexure at Annexure-I.

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v) The Contractors shall ensure proper safety of all the workmen, material, plant and equipment belonging to him or to the Employer or to others, working at the Site.

vi) All equipments used in construction and erection by the contractor shall meet BIS/International Standards and where such standards do not exist, the Contractor shall ensure these to be absolutely safe. All equipment shall be strictly operated and maintained by the contractor in accordance with manufacture's operation manual. The contractor should also follow guidelines/rules of the employer in this regard.

vii) The Contractor shall provide suitable latest Personal Protective Equipments of prescribed standard to all their employees and workmen according to the need. The Project Manager shall have the right to examine these safety equipments to determine their suitability, reliability, acceptability and adaptability. The contractor should also ensure these before their use at worksite.

viii) The Contractor shall provide safe working conditions to all workmen and employees at his workplace including safe means of access, railings, stairs and ladders, scaffolding, work platforms, toe boards etc. The scaffoldings shall be erected under the control and supervision of an experienced and competent person. For erection of scaffolds, access, work platforms etc. shall be good and the contractor shall us standard quality of material.

ix) The contractor shall follow and comply with all the safety rules, standards, code of practice of the Employer and relevant provisions of applicable laws pertaining to the safety of workmen, employees, plant and equipment as may be prescribed from time to time without any protest or contest or reservation. In case of any unconformity between statutory requirement and the Safety Rules of the Employer referred above, the latter shall be binding on the Contractor unless the statutory provisions are more stringent. As and when required he can refer/obtain copy of the Employer's safety documents as stated above.

x) The contractor shall have his own arrangements with nearby hospitals for shifting and treatment of sick and injured.

The medical examination of the works employed in hazardous areas shall be conducted as per Rule 223 of the Building and Other Construction Worker (Regulation of Employment and Condition of Service) Central Rule 1998 Their health hazard, the worker should be shifted to suitable place of working and properly treated under intimation to the Project Manager. The medical fitness certificate to be submitted to the Project Manager.

xi) First Aid boxes equipped with requisite articles as specified in the Rule 231 of The Building and Other Construction Workers (Regulation of Employment and Condition of Service) Central Rule 1998 shall be provided at construction sites for the use of workers. Training has to be provided on first aid to workmen & office bearers working at site.

39.02.00 **Emergency Action Plan**

The Contractor shall prepare an emergency action plan approved by his competent authority to handle any emergency occurred during construction work. Regular mock drills shall be organized to practice this emergency plan. The Emergency Action Plan should be widely circulated to all the employees and suitable infrastructure shall be provided to handle the emergencies.

39.03.00 **Flood Monitoring (Hydro Projects)**

The contractor shall take necessary measures for monitoring of flood/water levels and develop a forewarning system to evacuate people to safer places well before the flood occurs. For this purpose he may maintain liaison with meteorological department and with the Employer. The contractor shall make suitable communication and transporting system to rescuer and workers to safer places. The contractor shall provide suitable shelters, food, drinking water and other requisite facilities till they are brought back to their colonies and normalcy is restored.

39.04.00 **Scaffolding**

The contractor shall take all precautions to prevent any accidental collapse of scaffolding or fall of persons from scaffolding. The contractor should ensure that scaffolding are designed by a competent person and it erection and repairs should be done under the expert supervision. The scaffolding shall meet the required strength and other requirements for the purpose for which the scaffold is erected. The material used for scaffold conform to the BIS / International standards.

39.05.00 **Opening**

The Contractor shall ensure that there is no opening in any working platform/any floor of the building, which may cause fall of workers or material. Whenever an opening on a platform/any floor of the building is unavoidable, the opening should be suitably fenced and necessary measures for protection against falling objects or building workers from such platform are taken by providing suitable safety nets, safety belts or other similar means.

39.06.00 **Fencing of Machinery**

The contractor shall provide suitable fencing or guard to all dangerous and moving parts of machinery.

The contractor shall not allow any of the employees to clean, lubricate, repair, adjust or examine during machinery in motion, which may cause injury to the person.

39.07.00 **Carrying of Excessive Weight by a Worker**

The worker shall not be allowed to lift by hand or carry over his head, back or shoulder more than the maximum limit set by the prescribed rules for the construction workers.

39.08.00 **Dangerous and Harmful Gases/Equipment**

The contractor shall ensure that the workers are not exposed to any harmful gases during any construction activity including excavation, tunneling, confined spaces etc.

The contractor should not allow any worker to go into the confined space unless it is certified by the Project Manager to be safe and fit for the entry to such work place. Proper record and work permits should be followed to carry out such works.

39.09.00 **Overhead Protection**

The contractor shall ensure that any area exposed to risk of falling materials, articles or objects is roped off or cordoned off or otherwise suitably guarded from inadvertent entry of any person.

Wherever there is a possibility of falling of any material, equipment or construction workers while working at heights, a suitable and adequate safety net should be provided. The safety net should be in accordance with BIS Standards.

39.10.00 **Working at Heights**

All working platforms, ways and other places of construction work shall be free from accumulations of debris or any other material causing obstructions and tripping.

Wherever workers are exposed to the hazard of falling into water, the contractor shall provide adequate equipment for saving the employees from drowning and rescuing from such hazards. The contractor shall provide boat or launch equipped with sufficient number of life buoys, life jackets etc. manned with trained personnel at the site of such work.

Every opening at elevation from ground level through which a building worker, vehicle, material equipment etc. may fall at a construction work shall be covered and/or guarded suitably by the contractor to prevent such falls.

Wherever the workers are exposed to the hazards of falling from height, the contractor shall provide full harness safety belts fitted with fall arresting systems to all the employees working at higher elevations and life line of 8mm diameter wire higher elevations. Safety nets shall also be provided for saving them from fall from heights and such equipment should be in accordance with BIS standards.

The contractor shall provide standard prefabricated ladders on the columns where the workers are required to use them as an access for higher elevations till permanent staircase is provided. The workers shall be provided with safety belts fitted with suitable fall arresting system (Fall arrestors) for climbing/getting down through ladders to prevent fall from height.

39.11.00 **Handling of Hazardous Chemicals**

The Contractor will notify well in advance to the Project Manager of his intention to bring to the Site any container filled with liquid or gaseous fuel or explosive or petroleum substance or such chemicals which may involve hazards. The Employer shall have the right to prescribe the conditions, under which such container is to be stored, handled and used during the performance of the works and the Contract

shall strictly adhere to and comply with such instructions. The Project Manager shall have the right at his sole discretion to inspect any such container or such construction plant/equipment for which material in the container is required to b used and if in his opinion, its use is not safe, he may forbid its use. No claim due to such prohibition shall be entertained by the Employer and the Employer shall not entertain any claim of the Contractor towards additional safety provisions/conditions to be provided for/constructed.

Further, any such decision of The Project Manager shall not, in any way, absolve the Contractor of his responsibilities and in case, use of such a container or entry thereof into the site are is forbidden by the Employer, the Contractor shall use alternative methods with the approval of the Employer without any cost implication to the Employer or extension or work schedule.

Where it is necessary to provide and/or store petroleum products or petroleum mixtures and explosives, the Contractor shall be responsible for carrying out such provision and / or storage in accordance with the rules and regulations laid down in Petroleum Act 1934, Explosives Act 1948, and Petroleum and Carbide of Calcium Manual published by the Chief Inspector of Explosives of India. All such storage shall have prior approval of the Project Manager. In case any approvals are necessary from the Chief Inspection (Explosives) or any statutory authorities, the Contractor shall be responsible for obtaining the same.

The Contractor shall be fully responsible for the safe storage of his and his Sub-Contractor's radio-active sources in accordance with BARC/DAE (Bhabha Atomic Research Centre/Department of Atomic Energy, Govt. of India) Rules and other applicable provisions. All precautionary measures stipulated by BARC/DAE in connection with use, the contractor would take storage and handling of such material.

The Contractor shall provide suitable personal protective equipments to the workers who are handling the hazardous and corrosive substances including alkalis and acids.

As a precautionary measure the contractor should keep the bottles filled with distilled water in cupboard / Boxes near work place for emergency eye wash by worker exposed to such hazardous chemicals.

39.12.00 **Eye Protection**

The contractor shall provide suitable personal protective equipment to his workmen depending upon the nature of hazards and ensure their usage by the workers engaged in operations like welding, cutting, chipping, grinding or similar operations which may cause injuries to his eye.

39.13.00 **Electrical Hazards**

The contractor should ensure that all electrical installations at the construction work comply with the requirements of latest electricity acts/rules.

The contractor shall take all adequate measures to prevent any worker from coming into physical contact with any electrical equipment or apparatus, machines or live electrical circuits which may cause electrical hazards during the construction work. The contractor shall provide the sufficient ELCBs/RCCBs for al the portable equipments, electrical switchboards, distribution panels etc. to prevent electrical shocks.

The contractor should ensure use of single/double insulated hand tools or low voltage i.e. 110 volts hand tools.

The contractor should also ensure that all temporary electrical installations at the construction works are provided with earth leakage circuit breakers.

39.14.00 **Vehicular Traffic**

The contractor should employ vehicle drivers who hold a valid driving license under the Motor Vehicles Act. 1988.

39.15.00 **Lifting Appliances, Tools & Tackles, Lifting Gear and Pressure Plant & Equipment, etc.**

The contractor shall ensure all the lifting appliances, tools & tackles including cranes, etc. lifting gear including fixed or movale and any plant or gear, hoists, Pressure Plant and equipment etc. are in good condition and shall be examined by competent person and only certified shall be used at sites. Periodical Examination and the tests for all lifting/hoisting equipment & tackles shall be carried out. A register of such examinations and tests shall be properly maintained by the Contractor and will be promptly produced as and when desired by the Project Manager or by the person authorised by him.

39.16.00 **Excessive Noise, Vibration**

The contractor shall take adequate measures to protect the workers against the harmful effect of excessive noise or vibration. The noise should not exceed the limits prescribed under the concerned rules- Noise Pollution (Regulation and Control) Rules, 2000.

39.17.00 **Electrical Installations**

The contractor shall not interface or disturb electric fuses, wiring and other electrical equipment belonging to the Employer or other contractors under any circumstances, whatsoever, unless expressly permitted in writing by the Project Manager to handle such fuses, wiring or electrical equipment.

Before the Contractor connects any electrical appliances to any plug or socket belonging to the other contractor or the EMPLOYER, he shall

i) Satisfy the Project Manager that the appliances is in good working condition;

ii) Inform the Project Manager of the maximum current rating, voltage and phases of the appliances;

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iii) Obtain permission of the Project Manager detailing the sockets to which the appliances may be connected.

The Project Manager will not grant permission to connect until he is satisfied that:

The appliance is in good condition and is fitted with suitable plug; having earth connection with the body.

Wherever armored/metallic sheathed multi core cable is used, the same armored / sheathed should be connected to earth.

iv) No repair work shall be carried out on any live equipment. The Project Manager must declare the equipment safe and a permit to work shall be issued by the Employer/contractor as the case may be to carry out any repair/maintenance work. While working on electric lines/equipments whether live or dead, suitable type and sufficient quantity of tools will have to be provided by the contractor to electricians / workmen / officers.

v) The contractor shall employ necessary number of qualified, full time Electricians/Electrical Supervisors to maintain his temporary electrical installation.

The installation is provided with suitable ELCBs and RCCBs wherever required.

39.18.00 **Safety Organisation**

39.18.01 The contractor employing more than 250 workmen whether temporary, causal, probationary, regular or permanent shall employ at least one full time safety officer exclusively to supervise safety aspects of the equipments and workmen, who will coordinate with the Employer's Safety Officer. Further requirement of safety officers, if any, shall be guided by Rule 209 of the Building and Other Construction Worker (Regulation of Employment and Conditions of Service) Central Rule 1998. In case the work is being carried out through subcontractor, the employees/workmen of the sub contractor shall also be considered as the contractor's employees workmen for the above purpose.

In case of contractor deploying less than 250 workmen he should designate one of his Engineer/supervisor or the contractor himself (if he is directly supervising the work) as safety officer in addition to his existing responsibilities. The Engineer/supervisor should get at least 2 days safety training from any reputed organization or from the Employer before resuming the work. If already trained in past the declaration along with training certificate to be furnished to the Employer's safety officer.

39.18.02 The name and address of such safety officer of the Contractor will be promptly informed in writing to the EIC with a copy to the Project Safety Officer before he starts work or immediately after any change of the incumbent is made during currency of the contract.

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39.19.00	**Reporting of Accident and Investigation** In case any accident occurs during the construction/erection or other associated activities undertaken by the contractor thereby causing any near miss, minor or major or fatal injury to his employees due to any reason, whatsoever, it shall be the responsibility of the Contractor to promptly inform the same to the Project Manager, the Employer's Safety Officer with a copy to the Employer's Head of Project in the prescribed form and also to all the authorities envisaged under the applicable laws.
39.20.00	**Right to Stop Work**
39.20.01	The Project Manager shall have the right at his sole discretion to stop the work, if in his opinion the work is being carried out in such a way that it may cause accidents and endanger the safety of the persons and or property, and / or equipments. In such cases, the contractor shall be informed in writing about the nature of hazards and possible injury/accident and he shall comply to remove shortcomings promptly. The Contractor after stopping the specific work can, if felt necessary appeal against the order or stoppage of work to the Project Manager within 3 days of such stoppage of work and decision of the Project Manager in this respect shall be conclusive and binding on the contractor.
39.20.02	The Contractor shall not be entitled for any damages/compensation for stoppage of work, [Sub-Clause 39.20.01] due to safety reasons and the period of such stoppage of work shall not be taken as an extension of time for Completion of the Facilities and will not be the ground for waiver of levy of liquidated damages.
39.21.00	**Fire Protection** The Contractor shall provide sufficient fire extinguishers at place/s of work. The fire extinguishers shall be properly maintained as per relevant BIS Standards. The employees shall be trained to operate the fire extinguishers/equipment.
39.22.00	**Penalties** (i) If the Contractor fails in providing safe working environment as per the Safety Rules of the Employer or continues the work even after being instructed to stop the work by the Project Manager as provided in Clause 39.20.01 above, the Contractor shall be penalized at the rate of Rs.25,000/- per day or part thereof till the instructions are complied with and so certified by the Project Manager. However, in case of accident, the provisions contained in Sub-Clause 39.22.00(ii) below shall also apply in addition to the penalties mentioned in this sub-clause. (ii) If the Contractor does not take all safety precautions and / or fails to comply with the Safety Rules as prescribed by the Employer or under the applicable law for the safety of the plant and equipment and for the safety of personnel and the contractor does not prevent hazardous conditions which cause injury to this own employees or employees of other contractors, or the Employer 's employees or any other person who are at the Site or adjacent thereto, the

Contractor shall be responsible for payment of penalty to the Employer as per the following schedule :

(a) Fatel injury or accident causing death :

Penalty @10% of contract value or Rs. 5,00,000/- per person, whichever is less.

(b) Major injuries or accident causing 25% or more permanent disablement to workmen or employees.

Penalty @2.5% of contract value or 1,00,000/- per person whichever is less.

Permanent disablement shall have the same meaning as indicated in the Workmen's Compensation Act 1923. The penalty mentioned above shall be in addition to the compensation payable to the workmen/employees under the relevant provisions of the Workmen's Compensation Act 1923 and rules framed there under or any other applicable laws as applicable from time to time.

(iii) If any contractor worker found working without using the safety equipment like safety helmet, safety shoes, safety belts, etc. or without anchoring the safety belts while working at height the Project Manager/ Safety Officer of the Employer shall have the right to penalize the contractor for Rs. 200/- per person per day and such worker shall be sent out the workplace immediately and shall not be allowed to work on that day. the Project Manager/Safety Officer of the Employer will also issue a notice in this regard to the contractor.

iv) If two or more fatal accident occur at same site of the Employer under the contract of contractor during the period of contract and he has

(1) not complied with keeping adequate PPEs in stock or

(2) defaulted in providing PPEs to his workmen or

(3) not followed statutory requirements/ the Employer's safety rules or

(4) been issued warning notice by the Employer's head of the project on non observance of safety norms or

(5) not provided safety training to all his workmen, the contractor can be debarred from getting tender documents of the Employer for two years from the date of last accident.

The safety performance will also be one of the overriding criteria for evaluation of overall performance of the contractors by the Employer. The contractor shall submit the accident data including fatal/non-fatal accidents for the last 3 years where he has undertaken the construction activities Projects-wise along with the tender documents. This will also be considered for evolution of tender documents. If the information given by the contractor found incorrect, his contract will be liable to be determined.

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39.23.00	**Award** If the contractor's performance on safety front is found satisfactory i.e. without any fatal/reportable accident in the year of consideration; he may be considered for suitable award **"ACCIDENT FREE SAFETY MERITORIOUS AWARD"** as per scheme of the Employer.
40.00.00	**FOREIGN PERSONNEL**
40.01.00	The Contractor shall submit to the Employer data on all personnel he proposes to bring into India for the performance of the Works under the Contract, at least sixty (60) days prior to their departure to India. Such data will include for each person the name, his present address, his assignment and responsibility in connection with the works, and a short resume of his qualification, experience etc. in relation to the work to be performed by him.
40.02.00	Any person unsuitable and unacceptable to the Employer shall not be brought to India. Any person brought to India, if found unsuitable or unacceptable by the Employer, the Contractor shall within a reasonable time make alternate arrangements for providing a suitable replacement and repatriation of such unsuitable personnel.
40.03.00	No person brought to India for the purposes of the works shall be repatriated without the consent of the Employer in writing, based on a written request from the Contractor for such repatriation giving reasons for such an action to the Employer. The Employer may give permission for such repatriation provided he is satisfied that the progress of work will not suffer due to such repatriation.
40.04.00	The cost of passports, visas and all other travel expenses to and from India, incurred by the Contractor shall be to his account. The Employer will not provide any residential accommodation and/or furniture for any of the Contractor's personnel including foreign personnel and Contractor shall make his own arrangements for such facilities in the area allotted at Site, to him by the Employer for that purpose.
40.05.00	The Contractor and his expatriate personnel shall respect all Indian Acts, Laws, rules and regulations and shall not in any way interfere with Indian political and religious affairs and shall conform to any other rules and regulations which the Government of India, the Employer and the Employer may establish from time to time, on them. The Contractor's expatriate personnel shall work and live in close co-operation and coordination with their co-workers and the community and shall not engage themselves in any other employment neither part-time or full-time nor shall they take part in any local politics.
40.06.00	The Employer shall assist the Contractor, to the extent possible, in obtaining necessary permits to travel to India and back, by issue of necessary certificates and other information needed by the Government agencies.
41.00.00	**NOT USED**
42.00.00	**SHAFT ALIGNMENTS** All the shafts of rotating equipment shall be properly aligned to those of the matching equipments to as perfect accuracy as practicable. The equipment shall be free from

excessive vibration so as to avoid overheating of bearings or other conditions which may tend to shorten the life of the equipment. The vibration level of rotating equipments measured at bearing housing shall not exceed forty (40) microns and shall conform to VDI 2056.All bearings, shafts and other rotating parts shall be thoroughly cleaned and suitably lubricated before starting.

43.00.00 DOWELLING

All the motors and other equipment shall be suitably dowelled after alignment of shafts with tapered machined dowels as per the direction of the Employer.

44.00.00 CHECK OUT OF CONTROL SYSTEMS

After completion of wiring, cabling furnished under separate specification and laid and terminated by the Employer, the Contractor shall check out the operation of all control systems for the equipment furnished and installed under these specifications and documents.

45.00.00 COMMISSIONING SPARES

45.01.00 It will be the responsibility of the Contractor to provide all commissioning spares including consumable spares like indicating lights/lamps, diodes, fuses recorder charts, ink pads/pens etc. required for initial operation till the Completion of Facilities. The Contractor shall furnish a list of all commissioning spares within 60 days from the date of Notification of Award and such list shall be reviewed by the Employer and mutually agreed to. However such review and agreement will not absolve the Contractor of his responsibilities to supply all commissioning spares so that initial operation do not suffer for want of commissioning spares. All commissioning spares shall be deemed to be included in the scope of the Contract at no extra cost to the Employer.

45.02.00 These spare will be received and stored by the Contractor at least 3 months prior to the schedule date of commencement of initial operation of the respective equipment and utilised as and when required. The unutilised spares and replaced parts, if any, at the end of successful completion of performance and functional guarantee tests shall be the property of the Contractor and he will be allowed to take these parts back at his own cost with the permission of Employer.

46.00.00 EQUIPMENT DELIVERY AND ERECTION

46.01.00 **General Requirements**

a) This part covers Contractor's responsibilities for packing, shipping, warehousing and the installation of all equipment and materials furnished and installed under this specification.

b) The Contractor shall submit for Employer's approval draft manual for Equipment Delivery and Erection (EDE Manual) covering detailed instructions, check-lists, documentation formats for all activities after

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equipment manufacture upto installation of equipment. This manual shall cover general instructions for all equipment and specific instructions for individual equipment wherever required and shall include at least the following :

1) Instructions for packing, shipping, receiving handling, ware-housing and storage.

2) Instructions for location and installation of equipment furnished by this specification.

3) Installation drawings for field mounted equipment, panels, cubicles and other equipment covered under this specification.

4) Instruction relating installation of piping/ tubing, support and routing drawings of impulse pipes/signal tubes and tube/cable trays.

5) Check lists and quality assurance hold points.

6) Format for all related documentation.

c) The EDE Manual shall conform to the requirements of this specification, all applicable codes and standards, recommendations of equipment manufacturers and accepted good engineering practices and shall be subject to Employer approval during detailed engineering.

d) The Contractor shall ensure that all work under this part shall be performed as per the requirements of this specification, Employer approved EDE Manual and drawing/documents approved by the Employer during detailed engineering.

46.02.00 **Crating**

a) All equipment and materials shall be suitably coated, wrapped, or covered and boxed or crated for moist humid tropical shipment and to prevent damage or deterioration during handling and storage at the site.

b) Equipment shall be packed with suitable dessicants, sealed in water proof vapour-proof wrapping and packed in lumber of plywood enclosures, suitably braced, tied and skidded. Lumber enclosures shall be solid, not slatted.

c) Dessicants shall be either silica gel or calcium sulphate, sufficiently ground to provide the required surface area and activated prior to placing in the packaging. Calcium sulphate dessicants shall be of a chemical nature to absorb moisture. In any case, the dessicant shall not be of a type that will absorb enough moisture to go into solution. Dessicants shall be packed in porous containers, strong enough to withstand handling encountered during normal shipment. Enough dessicant shall be used for the volumes enclosed in wrapping.

d) Review by the Employer of the Contractor's proposed packaging methods shall not relieve the Contractor of responsibility for damage or deterioration to the equipment and materials specified.

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e) All accessory items shall be shipped with the equipment. Boxes and crates containing accessory items shall be marked so that they are identified with the main equipment. The contents of each box and crates shall be indicated by markings on the exterior.

f) All boxes, crates, cases bundles, loose pieces, etc. shall be marked consecutively from No.1 upward throughout all shipments from a given port to completion of the order without repeating the same number.

g) An itemized list of contents shall been closed inside each case and one other copy securely fastened to the outside of the case in a tin or light weight sheet metal envelope or pocket. The lists shall be plainly marked and placed in accessible locations to facilitate receipt and inspection. The packing list shall indicate whether shipment is partial or complete and shall incorporate the following information on each container, etc., according to its individual shipping number :

a) Export case markings

b) Case number

c) Gross weight and net weight in Kilograms

d) Dimensions in centimeters

e) Complete description of material

h) Packaging or shipping units shall be designed within the limitations of unloading facilities and the equipment which will be used for transport. Complications involved with ocean shipment and the limitations of ports, railways and roads shall be considered. It shall be the Contractor's responsibility to investigate these limitations and to provide suitable packaging to permit safe handling during transit and at the job site.

j) Electrical equipment, control and insulations shall be protected against moisture and water damage. All external gasket surfaces and flange faces, couplings, motor pump shafts, bearing and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection.

k) Equipment having antifriction or sleeve bearings shall be protected by weather tight enclosures.

l) Coated surfaces shall be protected against impact, abrasion, discolouration and other damage. Surfaces which are damaged shall be repaired.

m) All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors. All female threaded openings shall be closed with forged steel plugs. All pipings, tubing, and conduit equipment and other equipment openings shall be sealed with metallic or other rough usage covers and tapped to seal the interior of the equipment piping, tubing, or conduit.

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n) Provisions shall be made to ensure that water does not enter any equipment during shipment or in storage at the plant site.

p) Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

q) While packaging the material, care shall be taken for the limitation from the point of view of availability of railway wagon sizes in India.

46.03.00 **Factory Assembly**

a) Instrument enclosures shall be supplied and erected completely in the factory with instrument, air supply and blow down piping with necessary valves, fittings, etc. and also all electrical wiring between the instruments and the enclosure terminal blocks. Control panel and cubicles shall also be fully wired in the factory. Control panel mounted equipments are to be dismounted from the panels before shipment and individually packed for shipment. Electronic control modules of the plug-in type are to be removed from equipment racks after factory checkout are individually packed for shipment. Other equipment shall be fully assembled at the factory, except for necessary shipping splits in panels.

b) All separately packaged accessories items and parts shall be shipped with the equipment. Containers for separately packaged items shall be marked so that they are identified with the main equipment. An itemized packing slip, indicating what is in that carton only, shall be attached to the outside and inside of each container used for packing.

A master packing slip covering all accessories items for a given piece of equipment which are shipped in separate containers, shall be attached to one container.

46.04.00 **Equipment Installation**

a) General Requirements

i) The Contractor shall furnish all construction materials, tools and equipment and shall perform all work required for complete installation of all control and instrument equipment furnished under this specification.

ii) Contractor shall prepare detailed installation drawings for each equipment furnished under this specification for Employer's approval. Installation of all equipment/systems furnished by this specification shall be as per Employer's approval.

iii) Erection procedures not specified herein shall be in accordance with the recommendations of the equipment manufacturers. The procedures shall be acceptable to the Employer.

iv) The Contractor shall coordinate his work with other suppliers where their instruments and devices are to be installed under specifications.

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b) **Installation Materials**

All materials required for installation, testing and commissioning of the equipment shall be furnished by the Contractor.

c) **Regulatory Requirements**

All installation procedures shall confirm with the accepted good engineering practice and with all applicable governmental laws, regulations and codes.

d) **Cleaning**

All equipment shall be cleaned of all sand, dirt and other foreign materials immediately after removal from storage and before the equipment is brought inside the power plant building or to other installation sites. All piping and tubes shall be air blown.

e) **Equipment Assembly**

Equipment installed under these specifications shall be assembled if shipped unassembled. The equipment shall be dismantled and reassembled as required to perform the installation and commissioning work described in these specifications.

f) **Equipment Setting**

Field mounted instruments and accessories shall be bracket or sub panel mounted on the nearest suitable firm steel work or masonry. The brackets, stands, supports and other miscellaneous hardware required for mounting instruments and accessories such as receiver gauge, air set, valve manifold, purge-meter etc. shall be furnished and installed. No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on electrical connection to it.

Indicating type field mounted instruments shall be installed in such a way that centre of indicating dial shall be about 1600-1800mm from operating floor level. Non-indicating type field instruments shall be installed such that operating handle of manifold block/isolating cock comes within 1600 mm from operating floor level.

All free standing instrumentation cabinets and panels shall be located within the construction tolerances of +/- 3 mm of the location dimensions indicated on the Employer's plant arrangement drawings.

g) **Free-Standing Equipment**

Free-standing Cabinets shall be attached to the floor, concrete equipment bases or supporting steel as indicated on the manufacturer's drawings and the Employer's Plant Arrangement Drawings. The cabinets shall be shimmed for proper alignment before bolting them to the floor. Adjacent enclosures shall be shimmed to maintain mutually level appearance before they are attached to floor. Vibration dampening mounts shall be installed between supporting structures and panels when specified.

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h) **Non-free Standing Equipment**

i) Non-free standing local enclosures and cabinets shall be mounted in accessible locations on columns, walls, or stands in locations as indicated on the Employer's Plant Arrangement Drawings. Bracket and stands shall be fabricated as required to install the local enclosures and cabinets in a workman like manner.

ii) Rough edges and welds on all fabricated supports shall be ground smooth. The supports shall be finished with two coats of primer and two coats of paint as specified in this part.

i) **Equipment Location**

i) All individual items of equipment not located in cabinets or on panels and racks are located approximately according to the floor elevation and the nearest building column designated by the Employer.

ii) Solenoid valves not located in enclosures or mounted on valves shall be mounted in easily accessible protected locations near the components with which they are associated.

iii) All brackets, stands, supports and other miscellaneous hardware required for mounting devices shall be furnished and installed.

iv) Thermometers shall be installed in the process lines and ducts as required and adjusted for ease in reading.

v) Any required adapting hardware such as pipe bushings, nipples, drilled caps and the like shall be provided for complete installation of control devices into process connections.

For location of C&I related equipment/devices, please refer relevant Parts, Section-VI.

j) **Installation of Field Mounted Instruments and Devices**

The Contractor shall submit installation drawings for all field mounted equipment furnished under this specification for Employer's approval. These drawings shall meet the requirements of this specification, installation drawings, applicable codes and standards and recommendations of manufacturers of instruments/devices. All installation work under this specification shall be strictly as per installation drawings approved by the Employer during detailed engineering stage.

(Also refer relevant Parts, Section VI).

k) **Piping Connections**

i) All equipment having piping connections shall be levelled, aligned and wedged in place but shall not be grouted or bolted prior to the initial fitting and alignment of connecting piping. All equipment shall,

however, be grouted or bolted to its foundation prior to final bolting or welding of the connection piping.

ii) All flanged joints shall be checked and retightened after approximately 10 days of operation at normal operating temperature.

l) **Equipment Checkout**

1. All equipment shall be cleaned after installation. Equipment subject to pressure differentials shall be checked for leakage.

2. After erection, all equipment having moving parts, having electrical apparatus, or subject to pressure differentials shall be trial-operated.

m) **Defects**

i) All defects in erection shall be corrected to the satisfaction of the Employer and the Project Manager. The dismantling and reassembly of Contractor furnished equipment to remove defective parts, replace parts, or make adjustments shall be included as a part of the work under these specifications.

ii) The removal of control and instrument equipment in order to allow bench calibration, if required, and the re-installation of the said equipment after calibration shall also be included as a part of the work under these specifications.

n) **Equipment Protection**

i) All equipment to be erected under these specifications shall be protected from damage of any kind from the time of contract award until commissioning of each unit.

ii) The equipment shall be protected during storage as described herein.

iii) Equipment shall be protected from weld spatter during construction.

iv) Protective Guards

Suitable guards shall be provided for protection of personnel on all exposed rotating or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy removal and maintenance.

v) Equipment having glass components such as gauges, or equipment having other easily breakable components, shall be protected during the construction period with plywood enclosures or other suitable means. Broken, stolen, or lost components shall be replaced by the Contractor.

vi) Machine finished surfaces, polished surfaces, or other bare metal surfaces which are not to be painted, such as machinery shafts and couplings shall be provided temporary protection during storage and

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constructional periods by a coating of a suitable non- drying, oily type, rust preventive compound.

47.00.00 WELDING - SPECIAL REQUIREMENTS

If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed under separate specifications, the requirements shall be submitted to the Project Manager in advance of commencement of erection work.

48.00.00 DEVIATION DISPOSITIONING

Any deviation to the contract and employer approved document shall be properly recorded in the format prescribed by the Employer. All the deviations shall be brought to the knowledge of employer's representative for suitable dispositioning.

49.00.00 Non-Destructive Testing (NDT)

The Contractor shall record results of NDT, carried out at site in the format acceptable to employer. All the radiographs & its report duly signed & corrected to the job shall be handed over to the employer. Sensitivity of all the rest equipment shall be compatible to the job & acceptance norms agreed.

50.00.00 TESTING EQUIPMENT & FACILITIES

Contractor shall provide the testing equipment and facilities necessary to carryout tests & inspections.

ANNEXURE-I

Safety Plan

01. Safety Policy of the Contractor to be enclosed

02. When was the Safety Policy last reviewed

03. Details of implementation procedure/methods to implement Safety Policy / Safety Rules.

04. Name, Qualification, experience of Safety Officer

05. Review of Accidents Analysis Method, Methods to ensure Safety and Health.

06. Unit executive responsible to ensure safety at various levels in work area

07. List of employees trained in safety employed before execution of the job. give the details of training

08. Safety Training Targets, Schedules, methods adopting to providing safety training to all employees

09. Details of checklist for different jobs/work and responsible person to ensure compliance (copy of checklist to be enclosed)

10. Regular Safety Inspection Methods and Periodicity and list of members to be enclosed.

11. Risk Assessment, Safety Audit

12. Implementation of Recommendations of Audit/Inspections. Procedures for implementation and follow up

13. Provision for treatment of injured persons at work site

14. Review of overall safety by top management and periodicity

15. System for Implementation of Statutory legislation

16. Issue of PPEs to employees, Periodicity / stock on hand etc.

Signature

Head of the Organisation

with date & stamp

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PART - A

SUB-SECTION-V

FUNCTIONAL GAURANTEES, LIQUIDATED DAMAGES

RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI

1.00.00 FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND GUARANTEE TESTS

This section defines overall guarantees to be achieved by the equipments to be supplied in the scope of the Rammam Stage III Electro Mechanical Works EPC Contract Package. In addition to satisfying these conditions, the equipment supplied with this contract shall also satisfy and be subject to all guarantees stated elsewhere in the specifications.

The term "Performance Guarantees" wherever appears in this Sub-Section-V shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in this Sub-Section-V shall have the same meaning and shall be synonymous to "Guarantee Test(s)".

1.01.00 ELECTRICAL & MECHANICAL EQUIPMENTS

1.01.01 Performance Guarantees

1.01.01.01 **General Requirements**

a) The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipments/ systems covered in these specifications.

b) The Bidder shall demonstrate all the guarantees covered herein during functional guarantee / acceptance test. The Bidder shall conduct the field guarantee tests at site and guarantee tests on transformers in presence of Employer.

c) All costs associated with the tests shall be included in the bid price.

d) Field test (as per IEC-60041) shall form the final basis to establish fulfillment of guarantees of the turbine. Model tests as specified in (Part- B Sub-Section M1- Turbines) shall, however, be carried out by the manufacturer prior to taking up manufacture so as to satisfy the Employer, the optimality of the design to meet guaranteed values. Modifications in design, if necessary, shall be made so that the guaranteed performance can be obtained and the manufacturing shall commence only after satisfactory result are obtained in the model test. In case of failure to obtain satisfactory results to ensure guaranteed performance, the Employer reserves the right to cancel the contract.

e) Output and Efficiency test as per IEC-60041 shall be conducted at different heads and nozzle openings to determine guaranteed efficiency parameters. Any deviation from IEC-60041 shall be clearly stated in the offer. Turbine efficiency shall be measured by thermodynamic method. Bidder shall furnish details of test method, agency which will conduct the test, provisions to be made for field testing, calibration of instruments for purposes of test and all other relevant details in the offer. Bidder shall be under obligation to accept these tests for the purpose of determination of liquidated damages.

The Bidder can also propose an independent agency for conducting the field guarantee test in which case, the bidder shall submit the detail/credentials of such agencies along with the bid. The independent agency shall be subject to employer's approval.

f) The maxlmum output of the generator shall be guaranteed (within the limits of temperature rise specified) at rated power factor and at any voltage and frequency in the specified operating range.

Similarly, the weighted average efficiencies of the generator shall be guaranteed with terminal voltage of 11 KV and pf (lag) 0.90 respectively and temperature rise limits as specified in the specifications (Part-B, Section E0). Individual losses shall be established using calorimetric or retardation method and the efficiencies shall be determined by the summation of individual losses as per international code, IEC 34-2 or Indian Standard IS: 4889. The static excitation equipment losses shall also be included in the generator losses.

g) In case during functional guarantee / acceptance tests, it is found that the equipments/ systems have failed to meet the guarantees, the Bidder shall carry out all necessary modifications and/ or replacements to make the equipment / system comply with the guaranteed requirements at no extra cost to the Employer. However if the Bidder is not able to demonstrate the guarantees, even after the above modifications/ replacements within 90 days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer has the right to either of the following:

(i) For Category-I Guarantees :

Reject or accept the equipments/ systems/ plant, with Liquidated Damages as stipulated below.

The following guarantees are covered under Category-I guarantees:

- Generating Unit Overall (Maximum) Output (refer Cl. 1.01.02.01 below).
- Weighted average efficiency of turbine (refer Cl. 1.01.02.02 below).
- Weighted average efficiency of generator (refer Cl. 1.01.02.03 below)
- Transformer losses (refer Cl. 1.01.02.04 below).

(ii) For Category-II Guarantees – NIL

(iii) For Category-III Guarantees (Demonstration Parameters/ Capabilities)

Reject the equipments/ systems/ plant and recover from the Bidder the payments already made.

OR

Accept the equipments/ systems/ plant after assessing the deficiency in respect of various ratings/ performance parameters and capabilities and recover from the Contract Price an amount equivalent to the damages as determined by the Employer. Such damages shall however be limited to the cost of replacement of the equipment(s)/ system(s), replacement for which shall remove the deficiency so as to achieve the guaranteed performance. These performances shall be termed as "Category-III guarantees".

Guarantees other than those covered in Category-I and which have been stipulated in various sections of the Technical Specifications are covered under Category-III guarantees.

h) The guaranteed values of weighted average efficiency of turbine and generator and transformer losses furnished by the bidder in the guarantee schedule (Schedule-10A) shall not indicate any tolerances. However during measurements in field guarantee tests, tolerance, uncertainties as applicable shall be considered as per relevant codes as specified.

1.01.02 Guarantees under Category-I

The performance guarantees under Category-I, which attract liquidated damages, are as follows:

1.01.02.01 Guaranteed Generating Unit Overall Outputs

Field guarantee/ acceptance test of Generating Unit overall output shall be carried out on any one of the turbines/generating units selected by the Employer

The Bidder shall guarantee both following overall outputs for the generating units as a whole (turbine + synchronous generator) - net of excitation power:

- Continuous overload apparent power (maximum output) equal or greater than 44 MW

The above value shall be achieved under the conditions specified here after:

- rated net head: As specified in Sub-Section M-1 of Part-B
- rated frequency: 50 Hz,
- rated voltage between phases,

- rated power factor: 0.9 over-excited.

The complete generating unit shall achieve the guaranteed overall capacities reliably, continuously and safely when coupled to the grid. The operating characteristic quantities (temperatures, pressures, constraints) for each component shall remain within the specified boundaries in the specifications.

Operation as specified above shall not cause any deterioration or alteration of its mechanical and electrical characteristics or capabilities in any part, which may be detrimental to its proper operation. No permanent distortion, no loosening or play, no vibration, no metal drawn from bearing pads or sliding surfaces, no bearing deterioration, etc. with any one or all of its components at the maximum allowed temperature shall occur.

Tests shall be conducted as per the stipulation of the specifications.

The amount of Liquidated Damages on account of failure to meet the guaranteed generating unit overall maximum output shall be calculated as per clause 1.01.03 below.

1.01.02.02 Guaranteed Turbine Weighted Average Efficiency under Rated Conditions

Bidder shall guarantee the weighted average efficiency of the prototype turbine at rated net head in accordance with the following formula:

$$\eta_{t\,avg} = (0.10\,\eta_{t\,1.10} + 0.60\,\eta_{t\,1.00} + 0.20\,\eta_{t\,0.80} + 0.10\,\eta_{t\,0.60})$$

Where, $\eta_{t\,avg}$ = Weighted average efficiency of the prototype turbine at the design head.

$\eta_{t\,1.10}$ = Turbine efficiency at 110% of rated output

$\eta_{t\,1.00}$ = Turbine efficiency at 100% of rated output

$\eta_{t\,0.80}$ = Turbine efficiency at 80% of rated output

$\eta_{t\,0.60}$ = Turbine efficiency at 60% of rated output

Weighted average efficiency of the Prototype turbine shall be determined after installation and commissioning of the generating units on the basis of field acceptance tests on any unit, to be decided by the Employer.

The guarantee test shall be carried out by an independent laboratory or by the Bidder after approval by the Employer who shall fix the appropriate measurement uncertainties in accordance with IEC-60041.

Measurements shall be taken by application of the thermodynamic method, in compliance with IEC test standard.

Tolerances in computation of efficiencies shall be allowed in accordance with IEC Code 60041 "Field acceptance tests for hydraulic turbines".

The amount of Liquidated Damages on account of failure to meet the guaranteed weighted average efficiency of turbine at rated operating values shall be calculated as per Cl. 1.01.03 below.

1.01.02.03 Guaranteed Generator Weighted Average Efficiency

The generator weighted average efficiency shall be guaranteed by the bidder and the same shall be determined from the individual guaranteed efficiencies and test figures at four loads specified as under:

$$\eta_{g\,avg} = (0.10\,\eta_{g\,1.10} + 0.60\,\eta_{g\,1.00} + 0.20\,\eta_{g\,0.80} + 0.10\,\eta_{g\,0.60})$$

Where

$\eta_{g\,avg}$ = Weighted average efficiency of the generator as computed above.

$\eta_{g\,1.10}$ = Generator efficiency at 110% of rated output

$\eta_{g\,1.00}$ = Generator efficiency at 100% of rated output

$\eta_{g\,0.80}$ = Generator efficiency at 80% of rated output

$\eta_{g\,0.60}$ = Generator efficiency at 60% of rated output

Generator efficiency tests shall be conducted in agreement with the stipulation of the specifications on the first completed machine or on any other chosen by the Employer

Efficiency measurements shall be performed using the separated losses method and calorimetric measurement.

In case efficiency as determined by losses measured at site is within the tolerances permitted by IEC for losses, no liquidated damages would be levied. Further, if the actual efficiency so calculated is lower than the guaranteed value, liquidated damages would be levied as per the rates and acceptable shortfall limits as specified in Cl.1.01.03 below. In such a case the difference between actual measured efficiency and the guaranteed efficiency duly adjusted with IEC tolerance on losses shall be considered as shortfall.

1.01.02.04 Guaranteed Transformer Losses

The bidder shall guarantee iron loss, copper loss and cooler loss for generator transformers (11 Nos.) and the aggregate iron & copper losses considering the following transformers (other than the generator transformers) :

Transformer Description	Nos.
a) Station Transformers 132 kV/ 11.5 kV	2 Nos.
b) Unit Auxiliary Transformers 11 kV/0.433kV	3 Nos.

c)	Station Service transformers 11kV/0.433 kV	2 Nos.
d)	Barrage Supply Transformers 11kV/34.5 kV	2 Nos.
e)	Barrage Service Transformers 33kV/0.433 kV	2 Nos.
f)	Service Transformers 11kV/0.433 kV	4 Nos.

For the purpose of calculating liquidated damages, the loss in above transformers (other than the generator transformers) shall be determined as follows:

Aggregate Iron & Copper Loss in Transformers (KW) = (Total Iron loss-KW) + (0.25 x Total copper loss-KW)

The transformer losses shall be accounted based on the shop test reports.

The amount of Liquidated Damages on account of failure to meet the guaranteed transformer loss shall be calculated as defined in Cl. 1.01.03 below:

1.01.03 LIQUIDATED DAMAGES DUE TO SHORTFALL IN PERFORMANCE

If the performance guarantees specified at Cl.1.01.02.01, 1.01.02.02, 1.01.02.03 and 1.01.02.04 above are not met by the Bidder even after modifications and/ or replacements mentioned at Cl.1.01.01.01.(g) above, the Employer may at his discretion reject the equipment / system and recover the payment already made or may accept the equipment/ system after levying liquidated damages against the Bidder at the rates listed below and such Liquidated Damages shall be deducted from the Contract Price.

Parameter	Amount of Liquidated Damages (LD)
A) Generating Unit Output (maximum)	
For shortfall of every 0.01%* of guaranteed value (44 MW) by which the test value is less.	US$ 5500 (for each generating unit)
B) Turbine Weighted Average Efficiency##	
For shortfall of every 0.01%* of guaranteed value by which the test value is less.	US$ 5000 (for each turbine)

C) Hydro-Generator Weighted Average Efficiency##	
For shortfall of every 0.01% * in weighted average efficiency with respect to guaranteed value.	US$ 5000 (for each hydro-generator)
D) Transformers (other than generator transformers)	
For every KW ** increase in aggregate iron and copper losses with respect to guaranteed value.	US$ 2710
E) Generator Transformers	
For every KW** increase in iron loss with respect to guaranteed value.	US$1345 (for each generator transformer)
For every KW** increase in copper loss with respect to guaranteed value.	US$ 960 (for each generator transformer)
For every KW** increase in cooler loss with respect to guaranteed value.	US$ 1345 (for each generator transformer)

**For values less or more than 0.01%, the LD value shall be calculated in pro-rata basis.*

***For fractional KW increase in loss, the LD value shall be pro-rated for the fractional parts of the differential determined*

##Please refer Clause 1.01.02.02 & 1.01.02.03 of this Sub-Section above regarding tolerance applicable on guaranteed values of weighted average values of efficiency of turbine & hydro-generator respectively.

NOTE:

(i) Each of the Liquidated Damages specified above shall be independent and these Liquidated Damages shall be levied concurrently as applicable.

(ii) The Liquidated Damages due to shortfall in output and efficiency (as determined as per A), B) & C) above) for a single unit shall be multiplied by the number of units to calculate the total amount of Liquidated Damages on account of the same.

(iii) The Employer shall have the right to reject the equipment(s) if the tested values of either the generating unit output (A) or the turbine weighted average efficiency (B) or the hydro-generator weighted average efficiency (C) are less than the corresponding guaranteed figures by two percent (2%) or more after allowing for the tolerances as specified.

(iv) If the contract currency is other than US $, then the Liquidated Damages shall be in equivalent amount in Contract Currency based on Bill Selling Exchange Rate of State Bank of India prevailing on the date of award of Contract.

(v) All these Liquidated Damages for shortfall in performance shall be deducted from the Contract Price as detailed in the accompanying General Condition of Contract (GCC)/ Special Condition of Contract (SCC).

(vi) The Bidder's aggregate liability to pay Liquidated Damages for failure to attain the functional guarantee shall not exceed twenty-five percent (25%) of the Contract Price.

(CATEGORY –II GUARANTEES) : NIL

(CATEGORY –III GUARANTEES) : (Demonstration Parameters/ Capabilities)

(i) **Mechanical System**

As applicable and/or as specified in the technical specification in Mechanical Chapters.

(ii) **Electrical System**

As applicable and/or as specified in the technical specification in Electrical Chapters.

(iii) **Control and Instrumentation System**

As applicable and/or as specified in the technical specification in Chapter C-1E of Part-B, C&I section.

1.01.04 PERFORMANCE GUARANTEE/ ACCEPTANCE TEST

1.01.04.01 General Requirements

i. It is the responsibility of the Bidder to perform performance guarantee/ acceptance test as specified in the various sub-sections of the specifications (Part-B).

ii. The Bidder shall make the plant ready for the performance guarantee tests.

iii. All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Bidder shall get these instruments calibrated in an independent test Institute approved by the Employer. All test instrumentation required for performance tests shall be

supplied by the Bidder and shall be retained by him upon satisfactory completion of all such tests at site. All costs associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the bid price. All calibration procedures and standards shall be subjected to the approval of the Employer.

Tools and tackles, instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the Bidder free of cost.

iv. The Bidder shall submit for Employer's approval the detailed Performance Test procedure containing the following:

a) Object of the test.

b) Various guaranteed parameters & tests as per contract.

c) Method of conductance of test and test code.

d) Duration of test, frequency of readings & number of test runs.

e) Method of calculation.

f) Correction curves.

g) Instrument list consisting of range, accuracy, least count, and location of instruments.

h) Scheme showing measurement points.

i) Sample calculation.

j) Acceptance criteria.

k) Any other information required for conducting the test.

The Performance / Acceptance test shall be carried out as per the agreed procedure. After the conductance of Performance test, the Bidder shall submit the test evaluation report of Performance test results to Employer promptly but not later than one month from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the Employer after completing each test run.

QUALITY CO-ORDINATION PROCEDURE
NAME OF PROJECT : RAMMAM HPP
NAME OF PACKAGE : ELECTRO-MECHANICAL

1. PURPOSE

1.1The purpose of this document specifies the procedure to be adopted for coordination of QA & I Activities

1.2 This document is to be read in association with Engineering coordination procedure placed at Annex-II.

2. SCOPE

This document specifies procedure of :

- Correspondence between NTPC and Vendor
- Vendor approval
- Quality plan and field quality plan– approval/finalization
- Inspection/Testing of equipments/items
- Disposition of Non-conformities
- QA documentation Package
- Quality audit and surveillance

3. PROCEDURE

3.1 CO-ORDINATORS AND CORRESPONDENCE

3.1.1 Please Refer Engineering Coordination Procedure clause 1.0 & 2.0

3.1.2 The Correspondence concerning inspection shall be as per Clause No.3.5 described below.

3.2 VENDOR APPROVAL

3.2.1 List of items requiring vendor approval shall be identified in the NOA. The list contains, self manufactured items of the vendors/BHEL, the sub-vendors as proposed for bought out items (BOI's). The acceptable vendors/sub-vendors are marked 'A', sub-vendors not known to NTPC for which details are required to be submitted by as per Agreement are marked 'DR'.

3.2.2 The vendor shall ensure that all the orders for the identified BOIs are placed only on those sub-vendors approved in NOA and subsequently approved during execution of contract. Requirement of quality plan approval, NTPC inspection etc. shall be suitably tied-up with the sub-vendors in the purchase order.

3.2.3 Within 3 weeks of release of purchase order for bought out items/components, Vendor/BHEL shall furnish to NTPC, a copy of the unpriced purchase order for information.

3.2.4 Vendor shall submit the complete sub-vendor details (in NTPC prescribed format placed at Annexure-Q1) for 'DR' category, if required, which will include the following :

a) Manufacturing and Testing facilities, organizational set-up and catalogues/ drawings etc., giving constructional details of the item under consideration
b) System and procedure of proposed sub-vendor followed for inspection and testing of various items covered in this scope.
c) Vendor's evaluation report in the NTPC prescribed format (Annexure-Q2) .
d) Vendor's own experience including feedback from end user if applicable for the similar size/rating/application/MOC etc. Experience details of the sub-vendor shall include date of supply/commissioning.
e) Submission of the above details shall be as per mutually agreed schedule/approved L2 and project requirements.

3.2.5 Uploading of DR related documents: NTPC shall assign a specific document no for each DR category sub vendor on receipt of written request from the vendor. The vendor shall then upload request letter and duly filled questionnaire through 'c folder' against the document number. However remaining supplementary documents shall be submitted in hard copy within three days of uploading in the system. In case further details/clarifications are required the same shall be obtained through email/discussions.

3.3 **QUALITY PLANS (QP) :**

3.3.1 Please Refer Engineering Coordination Procedure clause 3.0
3.3.2 Vendor shall submit to NTPC, the quality plans in NTPC format placed at Annexure-Q3) after ensuring compliance of technical specification requirements as a minimum and putting the signature of authorized personnel of the vendor at appropriate place on each page of the quality plans. The quality plans shall be submitted alongwith reference documents/plant standards/NDT procedures/Welding specification/Heat Treatment details /Assembly & Performance test procedures as applicable as per the agreed schedule of submission of each quality plan as per MDL.
3.3.3 Wherever Reference Quality plan/Standard Quality Plan are available, vendor shall submit endorsement sheet as per NTPC format attached at Annexure-Q4.
3.3.4 Approval of QP in Cat-I is essential for NTPC inspection, dispatch of materials and issuance of MDCC.

3.4 **FIELD QUALITY PLANS (FQP) :**

3.4.1 Please Refer Engineering Coordination Procedure clause 3.0
3.4.2 Vendor shall submit the FQP for equipment and services in NTPC format (placed at Annexure-Q5) as per agreed schedule of submission as per MDL. The FQP shall include quality practices and procedures followed by

vendor/sub-vendors during various stages of site activities starting from material receipt, storage till final erection of respective equipment at site.

3.4.3 Wherever reference/standard Field quality plans are available, vendor shall submit endorsement sheet as per NTPC format attached at Annexure-Q4.

3.4.4 FQP checks shall be implemented by Vendors with the involvement of NTPC-FQA and NTPC-Erection groups as per the classification of checks agreed in the respective approved FQP.

3.4.5 Erection agency accepted by NTPC(QA) shall be as agreed as per list enclosed (wherever applicable). For approval of additional erection agency, relevant details shall be furnished by the vendor.

3.4.6 Vendor shall submit Field welding schedule for site welding activities of pressure parts, pressure vessels, heat exchangers & piping (applicable for Electro-Mechanical only). The welding consumables for all welding work shall be as per NTPC rationalized list of welding consumables.

3.5 **INSPECTION:**

3.5.1 The notice period for inspection of materials/ components/ equipments for witnessing of the CHP stages by NTPC, as per approved QP requirements, at the vendor's works shall be as follows:-

a) Vendors of Indian Origin : 15 working days.

b) Vendors of Foreign Origin : 45 working days.

3.5.2 All the matters regarding inspection call shall be coordinated as follows:

3.5.2.1 For supplies of Indian origin:

Vendor will issue the inspection calls in NTPC format (Attached at Annexure-Q6), to the concerned NTPC inspection office. The list of various NTPC-RIO's and their addresses along with their area of jurisdiction is attached at Annexure-Q7. The call shall include copy of relevant approved QP and Data-Sheet, as applicable, internal test/ inspection report, as applicable etc. Further, Vendor's representative shall be present during stage inspections along with NTPC representative as per approved QAP/inspection category. Vendor shall closely co-ordinate with NTPC-RIO for inspection of in house as well as bought out items.

3.5.2.2 For supplies of other than Indian Origin: Vendor shall issue Inspection call in NTPC format to concerned NTPC-QA/CTF as per the notice period mentioned under 3.5.1 above and after ensuring all documents like QAP, drawing data sheet/BBU etc as applicable are approved in Category-I.

3.5.2.3 Where witnessing of the test is waived off in writing by NTPC, Vendor shall proceed with the witness of test, which shall be deemed to have been carried out in the presence of NTPC inspector and Vendor shall forward duly certified copies of the inspection and test reports to the concerned NTPC-RIO.

3.5.2.4 In case of items where NTPC inspection is not involved, Vendor shall carry out the inspection as per approved quality norms and

shall forward duly certified copies of the inspection and test reports to the concerned NTPC-RIO.

3.5.2.5 For the tests witnessed by NTPC, or when the factory tests at identified CHP stages, have been satisfactorily completed including computation of test results, wherever applicable, NTPC inspector shall sign jointly with vendor/ authorized representative (as applicable per approved QP) on the CHP Clearance/ Interim Inspection report. In case of deviations or objections, NTPC inspector shall convey the same, in writing on the CHP report itself, for clarification by vendors.

3.5.2.6 Vendor will make available to the NTPC inspector internal documents, plant standards and procedures relevant to the checks / tests carried out on material / items / equipment. Further vendors shall also ensure the availability of approved drawings / data sheets and approved quality plan at the place of inspection.

3.5.3 As NTPC is approving and stamping all documents in soft copies, all documents regarding inspection shall be coordinated as follows for smooth and trouble free inspection:

a) The main contractor, upon receipt of electronically approved and stamped documents (i.e. drawings/ data sheets/ BOM/ Quality Plan etc.) from NTPC shall take one print out & authenticate the document through their authorized signatories.

b) The main contractor shall then send this approved copy to the sub-supplier through e-mail or on CD along with authenticated hard copy of approved document.

c) These documents i.e. NTPC approved and stamped soft copy and main contractor's authenticated hard copy of NTPC approved document must be available at the place of inspection so that NTPC inspecting engineer can make use of these documents at the time of inspection.

d) The documents being approved by NTPC can be opened easily in "Adobe Acrobat 5.0 & above & the availability of the same shall be ensured by the main contractor/ sub-supplier.

e) If at the place of inspection internet connection is not available or signal is weak i.e. documents can not be transmitted through e-mail, NTPC approved soft copy of the document shall be available in CD form at sub-supplier's premises.

3.6 INSPECTION PLAN:

3.6.1 To facilitate advance planning of inspection of supplies, in addition to giving inspection notice at identified CHP stages as per approved QP, Vendor shall furnish three monthly rolling inspection program (in NTPC format) every month, indicating schedule dates of inspection at identified CHP stages, such a program shall be updated each month and a copy of the same shall be made available to NTPC-PC also. Such program shall be confirmed by specific inspection calls in accordance with clause 3.5 above.

3.6.2 Above three monthly inspection program for shop manufactured and BOIs shall be furnished directly to the respective NTPC-RIOs.

3.6.3 Vendor shall furnish monthly inspection status report for previous month including pending calls and exceptions reports / NCR, on or before 7th of every month.

3.7 NON-CONFORMITY DISPOSITIONING PROCEDURE:

3.7.1 Whenever any deviation is observed with respect to relevant document and good engineering practices the same shall be referred by vendor along with justifications to NTPC-RIO, where inspection was raised by vendor in NTPC format (placed at Annexure Q8), for review and necessary action. This shall be done only after acceptance, with or without modification / corrective action. NCR can be raised irrespective of the CHP stages, to the concerned NTPC-RIO, in whose jurisdiction the item / equipment is being manufactured. NTPC decision shall be final and binding on the NCRs. Material shall be re-offered for stage inspection, as per the NCR disposal requirements specified by NTPC.

3.7.2 Non-conformities with respect to the site activities shall also be dealt with similar fashion except that the NCR in the specified format shall be routed through NTPC-FQA group.

3.7.3 Tests, as required by the approved documents (Cat-1 approved quality plan, drawing / datasheet, as applicable), NTPC-RIO / Authorized representative shall issue the MDCC, against approved BBU, as applicable.

3.8 RESPONSIBILITY FOR ISSUING MDCC

The responsibility of issuing MDCC shall be as follows:

3.8.1 Where inspection by NTPC is envisaged in QP (inspection category Cat- I):

INDIGENOUS SUPPLIES:

The concerned Regional Inspection Office under whose jurisdiction the manufacturer is located, inspecting engineer or reviewing engineer (in case of waiver of presence of NTPC engineer) shall issue the MDCC.

FOREIGN SUPPLIES:

For items directly despatchable to site from the foreign manufacturer, the MDCC shall be issued by NTPC's inspecting engineer. In case of waiver of presence of NTPC engineer, the MDCC shall be issued by CQA engineer on satisfactory review of test reports.

For items to be brought to Vendor works from the foreign manufacturer, before final despatch to site, for assembly on other equipment, MDCC shall be issued

by relevant NTPC-RIO after satisfactory activities at Vendor works and on review of CHP report of NTPC's inspecting engineer for inspection at foreign manufacturer's works or on verifying acceptance report of CQA, in case of waiver of presence of NTPC engineer for inspection at foreign source.

NOTE: Material inspection by RIO-A at the works of sub-contractor in their respective jurisdiction and dispatched to the works of the other sub-contractor for assembly or otherwise in the jurisdiction of RIO-B before final despatch to project site, shall be accorded despatch clearance on a CHP clearance report by RIO-A and the MDCC of the completed item / equipment will be issued by RIO-B as per the approved BBU.

3.8.2 In case, only review of Vendor's inspection report / test certificates by NTPC has been envisaged as per approved QP (inspection Category Cat-II), such reports shall be submitted to the concerned NTPC-RIO, in whose jurisdiction manufacturer is located.

3.8.3 In case of items where QP has not been envisaged at all (inspection category Cat-III), such material shall be cleared on the basis of Certificate of Conformity, which shall be submitted to concerned NTPC-RIO, in whose jurisdiction vendor (main contractor) is located.

4. QUALITY ASSURANCE DOCUMENTATION PACKAGE:

4.1 For details please Annexure-E of Engineering Coordination Procedure

5. QUALITY AUDIT:

5.1 The Vendor shall provide the necessary facilities to NTPC, for carrying out of the quality surveillance and audits as envisaged in the contract.

(NTPC)

(BHEL)

(PANKAJ KASTURE)

एनटीपीसी NTPC	PROJECT: RAMMAM STAGE-III (3X40MW) PACKAGE: ELECTROMECHANICAL PACKAGE SUPPLIER :BHEL CONT. NO.: CS-5602-003-9	LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB- SUPPLIER APPROVAL	ANNEXURE- ...C DOC. No. CS-5602-003-9 Page 29 of 153 Revision No. : 00 DATE: 22/01/2015 PAGE : 1 OF 1

SL.NO.	ITEM	QP/INSPN CAT	QP NO.	PROPOSED SUBVENDORS BY MAIN CONTRACTOR	PLACE	SUB-SUPPLIER APPROVAL STATUS/ CATEGORY	REMARKS
1	HVAC SYSTEM L1 Level Vendor SUB QR FOR VENTILATION SYSTEM (Refer Note 1 & 2)	I		BLUE STAR	MUMBAI	A	
		I		VOLTAS	MUMBAI	A	
		I		STERLING & WILSON	KOLKATA	A	
		I		C DOCTOR	KOLKATA	A	APPD FOR VENTILATION ONLY DR FOR AC SYSTEM
		I		ADVANCE VENTILATION	DELHI	A	
		I		S K SYSTEM	DELHI	A	
		I		ROOTS COOLING	NOIDA	DR	
		I		AIR LINK ENGRS	DELHI	DR	
		I		DRAFT AIR	AHMEDABAD	DR	
		I					

NOTE-1: Subject to Sub-QR clearance by Engg as per Technical Specification

NOTE 2: Comprehensive L-2 list of sub-vendors shall be finalized with the finally selected L-1 vendor but prior to order finalization on L-1 vendor by the Bidder.

1. **SYSTEM SUPPLIER / SUB-SUPPLIERSTATUS CATEGORY (SHALL BE FILLED BY NTPC).**

A –For those items proposed vendor accepted to NTPC. To be indicated with letter "A" in the list along with condition of approval, if any.

DR - for those items " Details Required " for NTPC review.

Noted: For those items accepted by NTPC without specific sub-vendor approval from NTPC and indicated as "NOTED" in the list.

2. **INSPECTION CATEGORY:**

CAT I : For those items the quality plans are approved by NTPC and final acceptance will be on physical inspection witness by NTPC.

CAT II : For those items the quality plans are approved by NTPC. However no physical inspection will be done by NTPC. The final acceptance by NTPC shall be on the basis of review of documents as per QP.

CAT III: For those items Main Supplier approves quality plans. The final acceptance by NTPC shall be on the basis of certificate of conformance by Main Supplier.

NTPC H Maury 9

Main Contractor 22.01.15 BIPIN KUMAR DY MGR/Q PEM

PART-QA

QUALITY ASSURANCE

(AS APPLICABLE FOR HVAC SYSYTEM EQUIPMENT)

RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI

690

RAMMAM STAGE-III HYDRO ELECTRIC POWER PROJECT (3 X 40 MW)

ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE

TECHNICAL SPECIFICATION

SECTION-VI

PART - QA

691

PART-QA

SUB-SECTION-QM

(MECHANICAL)

RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI

GTS MATERIAL PROCUREMENT AND MANUFACTURE

1.00.00 This specification concerns the procurement of materials and parts manufacturing methods (cutting, welding, etc.).

The minimum testing required from the Contractor is defined in the Appendix 1.

1.01.00 MATERIAL PROCUREMENT

1.01.01 PROCUREMENT SPECIFICATIONS

The Contractor shall submit a material procurement procedure.

For each part, the Contractor shall define the grade of materials and chemical composition in compliance with the functions of the part and compatible with manufacturing conditions, unless specified in each detailed specification.

The Contractor shall provide the materials in compliance with the following standards:

Material	Standard
sheets, rolled products	EN or equivalent
forging	EN, ASTM or equivalent
casting	EN, ASTM or equivalent

The following minimum thicknesses shall be observed for elements made of structural steels:

- steel plate, flats: 8mm
- steel bars and sections, tubes: 6mm
- embedded steel elements: 10mm

2.00.00 PROCUREMENT CONDITIONS

2.01.00 **Tests**

The compulsory tests to be implemented (mechanical properties, inspections, etc.) shall be defined by the Contractor in a procurement specification in the form of a table indicating the type of tests to be performed, unless indicated in detailed technical specifications.

2.02.00 **Final documents**

The identification of a part or product shall be ensured by individual marking. Traceability between the part or product and the acceptance inspection and test

reports shall be ensured either individually or by batch, depending on stipulated acceptance conditions.

2.03.00 **Supporting Documents for Choice of Materials**

The Contractor shall provide full technical support for his choice of materials for component procurement.

This support shall be based on analysis of all relevant data taken into account by the Contractor, in particular concerning design (dimension of parts), characteristics of the grades chosen, conditions for their treatment and implementation, and equipment operating conditions.

3.00.00 MATERIAL INSPECTION

3.01.00 **Chemical Composition**

The Contractor shall provide a description of the chemical composition specified and guaranteed for casting, forging and rolled products.

The Contractor shall provide chemical analysis of materials other than steel according to its classification of materials.

3.02.00 **Manufacturing**

3.02.01 **Technical manufacturing programme**

The Contractor shall specify whether or not a technical manufacturing programme is required.

3.02.02 **Delivery condition - heat treatment**

The Contractor shall specify the delivery condition required for parts or products (thermally treated condition, pickling or passivation operations, etc.)

The final quality heat treatment conditions shall be specified, in particular with the parameters of the cycles for this heat treatment, along with the instructions concerning temperature control.

3.03.00 **Mechanical Characteristics**

3.03.01 **Required mechanical characteristics**

The Contractor shall list the mechanical characteristics specified and guaranteed, along with those also requested for information (including, if applicable, characteristics at high temperature and rupture energy characteristics).

3.03.02 **Instructions for taking samples**

The Contractor shall specify the conditions under which samples shall be taken (condition of part or product, sample marking, etc.) as well as the sampling procedures.

3.03.03 **Tests to be performed**

The Contractor shall specify:

- batch definition,
- number and type of series of tests to be performed per batch,
- test performance procedures,
- the conditions allowing parts or products to be reworked, specifying the amount of reworking authorised.

3.04.00 **Non-Destructive Tests**

The non-destructive tests shall be achieved in compliance with the following standards:

material	ND test
sheets, rolled products	EN 10160(*) or equivalent
forging	See appendix 2
casting	CCH-70-3

(*) : EN 10160 "Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm" (dec. 1999)

3.05.00 **Visual Inspection**

The Contractor shall specify a procedure of visual inspection in accordance with admitted standard (ASME or equivalent) performed on the parts or products, with the scope of these tests and their associated acceptance criteria.

4.00.00 MANUFACTURE

4.01.00 **Identification and Marking of Products and Parts**

Products and parts to be used shall be marked for identification (e.g. equipped with permanent identification plates in readily visible locations). The inscription shall be printed, punched or engraved, and water-proof, oil-proof and wear-resistant.

Equipment manufacture may begin only if the base materials to be used have been identified.

The identification plates shall be protected during erection and especially during painting. Damaged identification plates shall be replaced by new ones.

Marking shall be performed in such a way that it shall not affect the material's behaviour under normal operating conditions.

5.00.00 MANUFACTURING

5.01.00 **Cutting**

Mechanical or thermal cutting shall be used to achieve the required size. Eliminating the zone hardened by mechanical or thermal cutting shall not be required, if this zone is either melted or restored during welding.

The Contractor shall examine the need to preheat prior to thermal cutting, according to grade of steel and thickness.

5.02.00 **Assembly**

The Contractor shall verify, by preliminary tests or by applying the rules set out in engineering codes, that the parts' mechanical characteristics (tensile strength, elongation, impact strength) have not been deteriorated by forming. If this cannot be proven, reconditioning heat treatment shall be applied.

5.02.01 **Welding**

The relevant chapter of ECC (Erection Condition of Contract) may be referred.

5.02.02 **Mechanical Assembly**

All mechanical assembly operations shall be described in a procedure specifying:

- the type of lubricant used,
- the required tightening torque or elongation value,
- the required tightening sequence and type of tools,
- alignment tolerances,
- functional clearances,
- the related dimensional inspections.

The lubricants used shall be stable at operating temperature and compatible with the materials with which they are in contact.

If manufacturing operations are likely to bring foreign materials into tapped bore holes, the latter shall be plugged for protection.

6.00.00 HYDROSTATIC TEST

Unless specified in detailed technical specifications, the Contractor shall undergo the following procedure.

Equipment under pressure shall undergo hydrostatic testing in the factory, except where previously agreed otherwise by the Contractor and the Employer.

Testing temperature shall be the normal operating temperature, and test pressure shall be 1.5 times the rated pressure or where there is a written waiver in the particular specifications.

The test shall last long enough to allow complete inspection of the parts under pressure. A hydrostatic test shall be considered satisfactory if neither leakage during testing nor significant permanent deformation after testing have been observed, with a minimum test time of 30 minutes. However, it may be necessary to increase test time for large thicknesses.

The Contractor shall prepare a report for every hydrostatic test.

All pressure and tightness tests shall be performed prior to surface treatment.

7.00.00 SURFACE TREATMENT

The Contractor shall respect the GTS "Surface Treatment and Coatings".

8.00.00 CLEANLINESS

During manufacturing, the Contractor shall take all the necessary measures to ensure that equipment is not contaminated by chemical products harmful to its withstand over time.

Before packaging for shipping, equipment cleanliness shall be inspected according to the criteria defined above-mentioned. This cleanliness inspection shall be recorded in a report specifying the equipment, the inspection performed, and inspection results. If necessary, the equipment shall be re-cleaned and shall undergo a second cleanliness inspection before shipping.

APPENDIX 1

CHART OF REQUIRED TESTS

The minimum testing required from the Contractor is defined in the charts hereafter. This document of required tests shall be confirmed and submitted by the Contractor to the Employer.

Meaning of symbols used in the chart

C	:	Part or element manufactured by casting
W	:	Part or element manufactured by welding
F	:	Part or element manufactured by forging
R	:	Part or element manufactured by rolling (laminated)
S	:	Part or element manufactured with shrunk-on sheets (electrical devices)
MC	:	Materials testing including verification of chemical composition and measurement of mechanical characteristics.
HT	:	Verification of heat treatment (report). If no symbol appears, there may be heat treatment with no issuance of a report.
VI	:	Volume inspection (radiography, ultrasonic testing)
SI	:	Surface inspection (dye penetrant test, magnetic particle inspection)
WS	:	Welding specifications
HTI	:	Hydraulic test inspection
Note	:	When a volume check (VI) or surface check (SI) is required by the chart, but the nature of that check is not established, the Contractor shall propose the most suitable method.

	Mfg.	PROCUREMENT							MANUFACTURING - ASSEMBLY - ERECTION							
	TYPE	STEEL SHEET			CAST or FORGED				WELDING				MANUFACTURING			
PELTON TURBINE	-	MC	HT	VI	MC	HT	VI	SI	WS	HT	VI	SI	VI	SI	VA	HTI
RUNNER HOUSING & PIT LINER	W	X		X					X	X		X			X	
GUIDE BEARING	F W	X		X	X		X		X			X		X(1)	X x	
MAIN SHAFT	F				X	X	X							X(2)	X	
THRUST BEARING SUPPORT	W	X													X	
THRUST RUNNER	C or F				X									X	X	
SHOE OR PAD	C or F or R							X						X	X	
RUNNER: 1. BUCKET	C				X	X	X	X						X	X	
2. OTHER PARTS	C/F				X	X	X	X						X	X	
3. RIM	C				X	X	X	X						X	X	
COUPLING BOLTS	F				X	X	X	X						X (3)	X	
NEEDLE SERVOMOTOR BODY	C W	X		X	X	X	X	X	X		X	X			X X	X X
NEEDLE SERVOMOTOR ROD	F				X	X	X	X						X(2)	X	

(1) Bonding of babbitt metal shall be checked by ultrasonic method on pads and shoes and by Dye penetration test on edges. (2) corner radius only by magnetic particle inspection - (3) Dye penetrant test before threading

IDENTIFICATION	MANUFA-CTURING	PROCUREMENT							MANUFACTURING - ASSEMBLY - ERECTION							
	TYPE	STEEL SHEET			CAST or FORGED				WELDING				MANUFACTURING			
		MC	HT	VI	MC	HT	VI	SI	WS	HT	VI	SI	VI	SI	VA	HTI
DISTRIBUTOR	W F	X												X X	X X	
NOZZLE SEAT RING	C													X	X	
NEEDLE	C/F													X	X	
NEEDLE STEM	F				X	X	X	X						X (1)	X	

(1) Corner radius only by MPI

(1) bonding of babbit metal shall be checked by ultrasonic method on pads and shoes and by dye penetrant test on edges.
(2) The Contractor shall provide a list of shells where a stress relieving is compulsory and the relevant method (HT or HTI).
(3) for safety bolts only.

IDENTIFICATION	MANUFACTURING TYPE	PROCUREMENT							MANUFACTURING - ASSEMBLY - ERECTION							
		STEEL SHEET			CAST or FORGED				WELDING				MANUFACTURING			
JET DEFLECTOR:		MC	HT	VI	MC	HT	VI	SI	WS	HT	VI	SI	VI	SI	VA	HTI
a. BODY	C				X	X	X	X						X	X	
b. CUTTING EDGES	C				X	X	X	X						X	X	
SPHERICAL/BUTTER-FLY VALVE	-															
Valve body or casing	C				X	X	X	X							X	X
	W	X		X					X	x	X	X			X	X
VALVE PLUG	F				X	X	X	X							X	
Valve disk	W	X		X					X	X	X	X			X	
	C				X	X	X	X							X	
Shaft and trunnion	F or C				X	X	X	X						X	X	
Servomotor body	C				X	X	X	X							X	X
	W	X		X					X		X	X			X	X
Servomotor rod	F				X		X							X	X	
Seal rings	C or F or W	X			X			X		X		X			X	

IDENTIFICATION	MFG. TYPE	PROCUREMENT							MANUFACTURING - ASSEMBLY - ERECTION							
		STEEL SHEET			CAST or FORGED				WELDING				MANUFACTURING			
		MC	HT	VI	MC	HT	VI	SI	WS	HT	VI	SI	VI	SI	VA	HTI
Bolting	F	X	X		X		X(1)							X(1)	X	
PRESSURE VESSEL																
Air/oil pressure tank	W	X		X					X		X	X			X	X
COMPRESSED AIR SYSTEM	ENCLOSED SEPARATELY															

(1) Dye penetrant test before threading for safety bolts only

Note: LONGITUDINAL SEAM WELDING IS NOT ALLOWED ON SERVOMOTOR BODY. LEAKAGE AND FUNCTIONAL TEST TO BE CARRIED OUT ON POWER PACK. LEAKAGE TEST AND FUNCTIONAL TEST TO BE CARRIED OUT ON HYD CYLINDER.

APPENDIX 2

FORGED PARTS

INVESTIGATION OF DEFAULTS

1.00.0 INVESTIGATION OF SURFACE DEFECTS

During various stages of manufacturing, surfaces are inspected closely to verify quality of steel.

Steel parts shall be sound and free from surface flaking, scale, crack, chipping mark, bed, notch or other defects detrimental to their use.

Controls by magnetic particle inspection or dye penetration tests shall be carried out according to all situations foreseen in appendix 1.

For dye penetration test, following criteria shall be applied:

- indications upper to 2 mm are taken into account,
- following indications shall be researched, removed and eventually repaired:
  - linear indications,
  - non-linear indications upper than 3 mm,
  - aligned indications out of 3 (three) or more, with a distance between each of less than 3 mm(edge to edge),
  - grouped indications out of 5 (five) on a surface of 100 cm2 (100 sqcm) chosen unfavourably according to the number of indication without exceeding an upper limit of dimension of 20 cm.

For magnetic particle inspection, following criteria shall be applied:

- indications upper to 2 mm are taken into account,
- following indications shall be researched, eliminated and eventually repaired:
  - linear indications,
  - non-linear indications upper than 3 mm,
  - aligned indications out of 3 (three) or more, with a distance between each of less than 3 mm (edge to edge), or stretching on more than 15 mm, if their distance edge to edge is between 3 and 6 mm.

Two distinct indications are deemed one if distance between each is lower than two times the length of the smallest.

The length of the agglomerated indication shall be equal to the lump sum of the length of the two indications and the gap between each.

For austenitic stainless steel, only dye penetration test shall be performed.

2.00.00 INVESTIGATION OF INTERNAL DEFAULTS

2.01.0 Inspections to be performed

Parts are examined by ultrasonic method before forming, according to conditions forecast in appendix 1. Inspection is performed according to arrangements of EN-10228 standard.

Scanning is carried out by a square pattern and dimensioning of indications is performed by the equivalent diameter method (longitudinal waves).

For hollow cylindrical parts belonging to 3a and 3b divisions, an inspection with transverse waves shall be carried out according to EN-10228 standard, using reference notch method.

The Contractor may avoid final check by ultrasonic method on parts manufactured with semi finished products which have undergone ultrasonic inspection during forming.

2.02.00 Acceptance criteria

2.02.01 Longitudinal waves

The Contractor shall take into account criteria of quality class 2, except for trunnions, hoops, pinions, lifting hooks and transmission shafts where criteria of quality class 3 shall be applied.

2.02.02 Transverse waves

The Contractor shall apply criteria of EN-10228 standard.

2.02.03 Removal of damaged area

The Contractor shall remove only surface defaults, except for the compliance of dimensional tolerance limits of the part. After removal of defaults, the Contractor shall undergo an inspection by dye penetrant test or by magnetic particle.

Forged parts shall not be repaired by welding.

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APPENDIX- 3

ASSEMBLY INSPECTION

No.	Components to be assembled	Assembly inspection	Remarks
TURBINE			
1.	Shaft and runner assembly	♦	Runout checks
2.	Runner housing and pit liner		
3.	Distributor Piping	♦	
4.	Deflector servomotor assembly		
5.	Needle servomotor assembly		
6.	Turbine bearing		
7.	Other stationary parts		
SPHERICAL/BUTTERFLY VALVE			
1.	Valve assembly	♦	
2.	Servomotor		
3.	Bye pass valve		
4.	Other valves		
GOVERNING SYSTEM			
1.	Actuator and Pilot Servomotor assembly & control		
2.	Oil Sump tank		Assembly to be tested for leakage

COOLING WATER SYSTEM / DRAINAGE- DEWATERING SYSTEM / COMPRESSED AIR SYSTEM			
1.	Pumps / Compressors		
2.	Piping / Compressors		

PRESSURE TEST / DIELECTRIC TEST / OTHER TESTS

No.	Components	Hydraulic pressure test	Remarks
TURBINE			
1.	Distributor	♦	Duration 30 minutes
2.	Needle servomotor		--do--
3.	Deflector servomotor		--do--
4.	Cooling coils for turbine bearing		--do--
5.	Turbine bearing oil tank		No leakage in one hour with light solvent filled
6.	Valves		--do--
	(a) Body		All type of valves to be covered
	(b) Seat		
7.	Piping		--do--
8.	Water /oil / air / piping		--do--
SPHERICAL / BUTTERFLY VALVE			
1.	Body	♦	
2.	Seat	♦	
3.	Valves		
	(a) Body		

	(b) Seat		
4.	Piping		
GOVERNING SYSTEM			
1.	Oil pressure tank for governor		
2.	Air pressure tank for governor		
3.	--do--brakes		

COOLING WATER SYSTEM / DRAINAGE- DEWATERING SYSTEM / COMPRESSED AIR SYSTEM			
No.	Components	Pressure test	Remarks
1.	Piping		Duration 30 minutes
2.	Valves		--do--
3.	Pumps		--do--
4.	Compressors		--do--
5.	Strainers		--do--

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OPERATIONAL TEST

No.	Particulars	Operational test	Remarks
TURBINE			
1.	Deflector Servomotor		Stroke check to be done
2.	Needle Servomotor		--do--
3.	Instruments		
SPHERICAL / BUTTERFLY VALVE			
1.	Servomotor		Stroke check to be done for hydraulic and electrical operations as applicable
2.	Other valves		
GOVERNING SYSTEM			
1.	Governor Electronic regulator	♦	
2.	Actuator/Pilot Servo Assembly		To be tested with a testing regulator and testing servomotor
3. a)	Oil Pressure Unit		i) Characteristic tests

b)	Non-return valves		i) Relationship between delivery pressure and delivered quantity ii) Voltage, current and efficiency
c)	Safety valves		Safety valve operation i) Characteristics ii) Operational checks
4.	Instruments		
5.	Speed relays		
6.	Oil pump		Pump capacity

COOLING WATER SYSTEM / DRAINAGE- DEWATERING SYSTEM / COMPRESSED AIR SYSTEM			
1.	Pumps		Pump capacity and head
2.	Compressors		Compressors capacity and pressure
3.	Strainer		Pressure loss across strainer

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NOTES/ABBREVIATIONS: -

Test/ inspection by manufacturer's inspector at his or vendor's works and test certificates to be submitted to Purchasers.

♦ Test by manufacturer's inspector and witness by Purchaser's inspector/consultants. This is the minimum requirements. It may be increased as per the requirements in other areas during finalization of QAP.

RT = Radiographic Test

UT = Ultrasonic Test

MT = Magnetic Particle Test

PT = Dye Penetration Test

SR = Stress Relieving

HV = High Voltage

Y = Yes

N = No

Note: -Above is an indicative list. The supplier shall have to submit a detailed list.

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Service Elevators (ELECTRICAL & MECHANICAL)

Passenger/ Service Elevators And Lifts

TESTS /CHECKS / Items	Material Test	DPI/MPI	Ultrasonic Test	Dimensions/Physical	Functional/ Operational Test/ Run Test	Performance Test	Other Tests	All routine tests as applicable standard	Plain shade, thickness & adhesion	Assembly/fit up
Shaft/ Rack/Gears	Y	Y	Y	Y						
Geared Machine					Y					
VVVF Panel				Y	Y		Y3	Y	Y	
Electrical motor				Y	Y			Y		
Complete Lift/ Elevator				Y	Y	Y1	Y2			Y

Y1 –TEST TO BE DONE AT SITE

Y2 - LOAD/OVERLOAD TEST TO BE DONE AT SITE AS APPLICABLE.

Y3 – Burn in test on electronic card

NOTE: 1. This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the applicable practices and procedures followed along with relevant supporting documents during QAP finalization.

2. Makes of all bought out items shall be subject to NTPC approval.

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EQUIPMENT COOLING WATER SYSTEM

	TEST / CHECKS / ITEM / COMPONENTS	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit Up	Visual & Dimensional Check	UT	RT	Hydraulic / Water Fill	Balancing	Type Test	Performance Test	Other Test
A	**PLATE TYPE HEAT EXCHANGER**		Y	Y[3]	Y	Y			Y				
A.1	Heat Transfer Plates	Y[1]		Y[2]		Y							Y
A.2	Gaskets	Y				Y							
A.3	Cover Plates (Front & Rear)	Y[1]				Y	Y[5]						
A.4	Tie Rods	Y[1]		Y[4]			Y[6]						

NOTES

1 One per heat / HT batch

2 DP Test shall be conducted for 10% of the lot of HT plates. However, in case of any defect, entire lot shall be tested and only defect free plates shall be accepted.

3 100% DP Test shall be conducted on butt welds and 10% DPT on fillet weld after final run.

4 100% DPT shall be carried out on machined surfaces.

5 UT shall be done on plates with thickness 25 mm or above.

6 UT shall be done on shaft / tie rod with diameter 50 mm or above.

7 Each Plate after pressing shall be subject to either of the following tests, as per Manufacturer Practice
a) Light Box Test b) Vacuum Test c) Air Chamber Test

The complete corrugations in HT plate shall be achieved by single pressing operation.

COOLING WATER SYSTEM

	Items / Components \ Tests/Check	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Ultrasonic test	RT	Balancing	Hydraulic / Water Fill test	Pneumatic Test	Assembly/ fit up	Dimensions	Functional/operational Test	Performance Test	Other Test	All Test as per relevant Standard/ Approved Data Sheets	Remarks
A.	**PUMPS ***									Y[1]	Y		Y[2]			
1	Shaft	Y[a]		Y[b]	Y[c]						Y					
2	Impeller	Y[a]		Y[b]		Y[3]	Y									
3	Suction Bell / Bowl Castings/ Inserts	Y[a]		Y[b]				Y			Y			Y[6]		
4	Discharge Head / Column Pipes / Distance Piece	Y[a]	Y	Y[b]		Y[4]		Y		Y				Y[5]		
B.	**BUTTERFLY VALVES**							Y[7]		Y	Y	Y		Y[8]	Y	
1	Body & Disc	Y[a]		Y[b]										Y[9]		
2	Shaft	Y[a]		Y[b]	Y[c]											
3	EH Actuators	Y[a]		Y				Y	Y	Y		Y				
C.	**RE JOINTS**	Y[a]						Y[10]		Y	Y			Y[11]		
D.	**STOP LOG GATES**	Y[a]		Y[b]						Y	Y			Y[12]		
E.	**R & W PIPES**	Y[a]		**REFER NOTE 13**												
F.	**CRANES & HOISTS**	Y[a]		Y[b]	Y[c]	Y[14]				Y	Y	Y		Y[15]	Y[16]	

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	Items / Components \ Tests/Check	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Ultrasonic test	RT	Balancing	Hydraulic / Water Fill test	Pneumatic Test	Assembly/ fit up	Dimensions	Functional/operational Test	Performance Test	Other Test	All Test as per relevant Standard/ Approved Data Sheets	Remarks
G.	**VENTILATION FANS**										Y		Y			
1	Hub/Blades/Casing /Impeller	Y		Y			Y									
2	Shaft	Y[a]		Y	Y[c]											
3	Pre/Fine Filters													Y[1,7]		

*** PUMPS mean Pumps in primary and secondary circuits**

Notes:

a	One per Heat/ Heat Treatment Batch/ Lot.
b	On machined surfaces only for Castings / Forgings and on Welds of Fabricated Components. 100% DP test on butt weld joints of Girder, End Carriage, Crab (in tension, compression) and in butt weld joint of rope drum
c	For Shaft diameter. ≥ 40 mm and for forged part / plate thickness ≥ 40 mm (in case of EOT crane components)
1	Trial assembly of all Vertical Turbine Pump components with Column Pipes, Discharge Head, and Motor Stool shall be carried at shop.
2	Performance testing of Pumps shall be carried out at shop, as per HIS standard to determine Head & Flow Characteristics.
3	Radiographic Examination shall be conducted as per ASTM E186/E446 with Severity Level 2 for Gas porosity, Level 3 for Sand, Slag and Shrinkage. Cracks, Inserts and Mottling are not acceptable. Radiographic Examination should cover Vanes, Vane Junctions, Full Radial depth of Hub & other accessible areas of the rest of the Impeller.
4	Spot Radiography for Butt weld of Fabricated Components for thickness of 10mm & above shall be carried out.
5	Segmental Flanges exceeding 37.5 mm thickness shall be stress relieved after welding. All butt weld joints in segmental flange shall be examined by Radiographic Test. (RT may be replaced by Ultrasonic Test due to constraint if any.) Maximum number of segments shall be 4 only.
6	No repair welding is permitted on Cast Iron / Alloy Cast Iron Castings.

7	Hydraulic Test of Body, Seat and Disc strength shall be carried out in accordance with latest edition of AWWA C-504. Actuator operated Valves shall be checked for Seat Leakage by closing the Valve with Job Actuator. Seat Leakage test shall be carried out in both directions.
8	Proof of Design Test shall be carried out in presence of Owner's representative, if not carried out earlier under Third Party Inspection, in line with AWWA C-504 requirements. In case of Valves > 72" size, number of Cycles shall be 1000, for each Size & Class of Valve offered. Valve subjected to POD Test shall not be supplied to Owner.
9	For Butterfly Valves of Fabricated construction (Sizes 600mm and above) Butt Welds of thickness 20mm & above shall be subjected to 100% Radiography and Component shall undergo stress relieving.
10	During Hydraulic & Vacuum test at 25mm Hg absolute in 3 different positions, the change in Circumference of the Arch should not be more than 1.5%. Permanent Set, after 24 hours of the test, should not exceed 0.5% of Arch.
11	Tests on Rubber for Tensile, Elongation, Hardness, Hydraulic Stability as per ASTM D-471, Ozone Resistance test as per ASTM D-1149, Aging test, Fabric Strength of Synthetic Fiber, Adhesion strength of Rubber to Fabric and Rubber to Metal shall be carried out.
12	Smooth operation and Leakage test shall be carried out at site.
13	Followings are the testing requirements for fabrication of pipes at site / manufacturing works

Tests	**Quantum of Check**
WPS, PQR, Welder Qualification Test	100%
DPT on root run	100% for pipes up to 1200 mm diameter
DPT after back gauging	100% for pipes above 1200 mm diameter
RT	5%
DPT on finished butt weld joints	10%
Hydraulic Test	1.5 times the design pressure or 2 times the working pressure which ever is higher.

	Note:- Butt weld joints which can not be hydraulic (pressure) tested; shall be examined 100% by Radiographic Test (RT)
14	100% RT shall be carried out on Butt – weld joints in tension and in Butt Weld Joints of rope drum. 10% RT shall be carried out on Butt – weld joints in compression.
15	Reduction gears shall be tested for reduction ratio, backlash and contact pattern. Gear box shall be subjected to no – load test to check for oil leakage, temperature rise, noise and vibration.
16	Full Load and Overload test shall be carried out at shop as per the governing standard. All motions including performance of Electro-Mechanical Brakes if any shall also be checked.
17	Type / Routine tests as per requirements of BS-6540/ ASHRAE-52-76 for Dust arrestance shall be carried out.

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1.00.00	**HOOKS**
1.01.00	ALL TESTS INCLUDING PROOF LOAD TEST AS PER RELEVANT IS BS / DIN SHALL BE CARRIED OUT.
1.02.00	MPI/DPT SHALL BE CARRIED OUT AFTER PROOF LOAD TEST.
2.00.00	**STEEL CASTING**
2.01.00	DPT ON MACHINED SURFACE SHALL BE CARRIED OUT.
3.00.00	**GIRDERS, END CARRIAGE, CRAB, GEAR BOX AND ROPE DRUM**
3.01.00	THE PLATES OF THICKNESS 25MM AND ABOVE SHALL BE ULTRASONICALLY TESTED.
3.02.00	NDT REQUIREMENTS ON WELDMENTS SHALL BE AS FOLLOWS: BUTT WELTS IN TENSION: - 100% RT AND 100% DPT BUTT WELTS IN COMPRESSION: - 10% RT AND 100% DPT BUTT WELTS IN ROPE DRUM: - 100% RT AND 100% DPT FILLET WELDS: - RANDOM 10% DPT
4.00.0	**FORGING (WHEEL, GEARS, PINIONS, AXLE, HOOKS & HOOK TUNION)** ALL FORGINGS GREATER THAN OR EQUAL TO 50 MM DIAMETER OR THICKNESS SHALL BE ULTRASONICALLY TESTED.
4.01.00	DPT/MPI SHALL BE DONE AFTER HARDFACING AND MACHINING.
4.02.00	WIRE ROPE SHALL BE TESTED AS PER RELEVANT STANDARD.
4.03.00	REDUCTION GEARS SHALL BE TESTED FOR REDUCTION RATIO, BACHLASH & CONTACT PATTERN. GEAR BOX SHALL BE SUBJECTED TO NO LOAD RUN TEST TO CHECK FOR OIL LEAKAGE, TEMPERATURE RISE, NIOSE AND VIBRATION.
4.04.00	THE CRANES SHALL BE COMPLETELY ASSEMBLED AT SHOP FOR FINAL TESTING. ALL TESTS FOR DIMENSION, DEFLECTION, LOAD, OVERLOAD, HOISTING MOTION, CROSS TRAVELL ETC. AS PER IS-3177 SHALL BE CARRIED OUT AT SHOP.
4.05.00	ALL ELECTRIC HOISTS SHALL BE TESTED AS PER IS-3938 AND CHAIN PULLEY BLOCKS SHALL BE TESTED AS PER IS-3832.
4.06.00	LIFTING BEAM TEST LIFTING BEAM SHALL BE SUBMITTED TO SUITABLE TEST DURING MANUFACTURING

1.00.00	**FIRE PROTECTION SYSTEM**
1.01.00	**HYDRANT SYSTEM-SHOP TESTS**
1.01.01	Hydrant Valve: a) All valves shall be hydro tested for body and seat. b) Capacity test / flow test shall be done as per relevant standard.
1.01.02	Water Monitor, Hoses, Branch Pipes, Couplings and Nozzles a) All tests including hydraulic test shall be done as per relevant Indian / International standard.
1.01.03	For Pumps, refer the requirements indicated separately.
1.02.00	**HIGH / MEDIUM VELOCITY WATER SPRAY SYSTEM-SHOP TESTS**
1.02.01	For Pipes, Fittings, Valves and specialities, requirements are indicated separately.
1.02.02	Deluge Valve and Spray Nozzles a) All valves shall be hydro tested for body and seat. b) Performance test / functional test of 'Deluge Valve' and 'Spray Nozzles' shall be carried out.
1.02.03	Detectors a) All 'Detectors' shall be tested as per relevant Indian / International Standards. Detectors shall also meet the requirements of UL / FM / LPC etc.
1.03.00	**INERT GAS EXTINGUISHING SYSTEM**: (Control Room / Generator protection etc.)
1.03.01	a) Complete system selection / Major components shall be approved by TAC / UL / FM / LPC etc. b) Storage Cylinders / Containers with all accessories, all piping, valves, fittings and nozzles shall be subjected to all tests as per the design code to which they are supplied and shall also meet the requirements of TAC / UL / LPC / FM / NFPA etc. c) Storage Containers shall also meet the statutory requirements of approval / acceptance by CCE. d) Test for fill density, weight, leakage etc. shall be done for charged cylinders / containers.
1.04.00	**VERTICAL / HORIZONTAL CENTRIFUGAL PUMP-SHOP TESTS** a) UT on Pump Shaft (>= 50mm dia) and MPI / DPT on Pump Shaft and Impeller shall be carried out.

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b) All rotating components of the pumps shall be statically and dynamically balanced as per ISO: 1940 Gr. 6.3 or better.

c) Hydraulic test shall be conducted on pump casing with water at 1.5 times the shut off pressure or twice the head pressure whichever is higher for a minimum duration of 30 minutes.

d) Performance test and Standard Running test:

(i) All the pumps shall be tested in the manufacturer's works for capacity, efficiency, head and brake horse power. Pump shall be given running test over the entire operating range covering the shut off head to the maximum flow. The duration of test shall be minimum one hour. A minimum of five readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pump shall be in accordance with stipulations of Hydraulic Institute Standard (HIS) and / or as per applicable Indian Standard or equivalent. Tolerance on parameters shall be as per HIS.

(ii) The test shall be conducted at the rated speed preferably with the type tested contract drive motor being furnished. However, in case of any limitation, test bed motor duly calibrated can also be used.

(iii) Noise and Vibration shall be measured.

(iv) Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level / vibration are observed during the shop test.

1.05.00 **PRESSURE AND STORAGE VESSELS-SHOP TESTS (if concrete tank is constructed, this is not applicable)**

1.05.01 Atmospheric Tank

a) All weld joints shall be DP Tested and complete tanks shall be water fill tested.

b) All atmospheric storage tanks fabricated and erected at site shall be subjected to all tests (Hydro, NDT, Vacuum) according to design code as applicable.

1.05.02 Pressure Vessel

a) Each finished vessel shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.

b) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below :

(i) 100 % DPT on root run of butt weld.

(ii) 10% DPT on all finished butt welds and fillet welds.

(iii) 10% RT (covering all 'T' / cross joints) of butt welds.

1.05.03 Butt welds of dished ends shall be stress relieved and subjected to 100% RT.

1.06.00 **PIPING, VALVE AND SPECIALITIES-SHOP TESTS**

1.06.01

a) All pipes and fittings shall be tested as per applicable code.

b) DPT of pipe welds (in case of rolled and welded pipes only) shall be carried out for root and finished welds.

c) All strainers shall be subjected to Hydraulic pressure test for leakage and Pressure drop v/s Flow for each type and size.

d) All valves shall be hydraulically tested for body, seat and back-seat (if applicable) as per relevant standard. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.

e) Valves shall be offered for hydro test in unpainted condition.

f) Functional checks of the valves for smooth opening and closing shall also be done.

g) Anti-corrosive protection shall be tested as per applicable code.

1.07.00 **PORTABLE & MOBILE FIRE EXTINGUISHERS -SHOP TESTS**

1.07.01

a) All Fire Extinguishers shall be tested as per relevant standard.

b) Performance / function test shall be carried out on sampling basis as per relevant code / standard.

1.08.00 **SITE TESTS**

a) Fire Extinguishers: A performance demonstration test at site of five (5) percent or one (1) number, whichever is higher, of each type and capacity of the extinguisher shall be carried out by the contractor. All consumables and replaceable items require for this test would be supplied by the contractor without any extra cost to employer.

b) Welding of Pipes:

(i) ERW Black / rolled welded

100% DPT on root of butt and finish weld of butt and fillet.
RT on 10% randomly selected joints shall be carried out (for underground piping).

(ii) GI Pipes

Welding on GI Pipes in general shall not be done. Welding of GI Pipes, if permitted by design, (butt / socket / fillet weld) shall be done strictly as per approved drawing and procedure approved by NTPC – Engg. For all such welds minimum 100% DPT and 1% RT shall be done.

VENTILATION & A.C. SYSTEM

1.00.00	**PACKAGED AIR CONDITIONERS (PAC)**
1.01.00	Compressor of packaged air conditioner shall be tested as per relevant codes.
1.02.00	PAC shall be subjected to production routine test in accordance with IS: 8148 for the following. a) General Running Test b) Pressure/Leakage test c) Insulation Resistance test d) High Voltage test e) Performance test on one PAC at ambient conditions
2.00.00	**AHU (AIR HANDLING UNIT)**
2.01.00	20% DPT of welding on fan casing, impeller, hub & blades as applicable shall be carried out.
2.02.00	UT on fan shafts (dia equal to or above 50mm) shall be carried out. DP of fan shaft after machining shall be carried out
2.03.00	Rotating components of fan shall be dynamically balanced to ISO 1940 Gr. 6.3
2.04.00	One fan of each type and size shall be performance tested as per AMCA / BIS for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise and Vibration.
2.05.00	One per type of assembled AHU (AHU casing and fan assembly) shall be subjected to free run test. Noise, Vibration and Temp. Rise of bearing shall be measured during run test.
2.06.00	All cooling coil shall be pneumatically tested and no leakage shall be permitted.
3.00.00	**FANS**
3.01.00	20% DPT of welding on fan hub, blades, casing and impeller as applicable shall be carried out.
3.02.00	DPT of fan shafts shall be carried out after machining.
3.03.00	UT of fan shafts (dia equal to or above 50mm) shall be carried out.
3.04.00	Rotating components of all fans shall be dynamically balanced to ISO-1940 Gr. 6.3
3.05.00	All Centrifugal Fans shall be subjected to run test for 4 hrs. or till temperature stabilization is reached. Vibration, Noise level, Temp. rise and current drawn shall be measured during the run test.

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3.06.00	One fan of each type and size will be performance tested as per corresponding BIS code for Air flow, Static Pressure, Speed, Efficiency, Power Consumption, Noise, Vibration and Temp. Rise.
4.00.00	**CENTRIFUGAL PUMP**
4.01.00	UT on pump shaft (dia equal to or above 50 mm) and MPI/DPT on pump shaft and impeller after machining shall be carried out.
4.02.00	All rotating components of the pumps shall be dynamically balanced to ISO-1940 Gr. 6.3
4.03.00	A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the shut off pressure on the head characteristics curve or twice the rated pressure whichever is higher, for a minimum duration of 30 minutes.
4.04.00	Standard Running Test
4.04.01	All pumps shall be tested in the manufacturer's works preferably with contract motor for capacity, efficiency, head and brake horsepower. Pump shall be given running test over the entire operating range covering from the shut-off head to the maximum flow. The duration of test shall be minimum one (1) hr. A minimum of five readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standard (HIS) and/or as per applicable Indian Standard or equivalent. Acceptance norms shall be as per approved datasheet & HIS standard only.
4.04.02	Noise and vibration shall be measured at shop for reference purpose only.
4.04.03	Pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and/or excessive vibration are observed during the shop test.
4.04.04	NPSH test shall be conducted with water as the medium, if required as per approved data sheets.
5.00.00	**LOW PRESSURE AIR DISTRIBUTION SYSTEM**
5.01.00	Functional test for fire damper along with solenoid shall be done.
5.02.00	Prototype tests report of fire damper (duly approved/accepted by ENGG) for each type and size as per UL-555 for fire rating shall be furnished.
5.03.00	Site Test- After completion, all ducting system shall be checked/ tested for air leakages/tightness (smoke test) at site.
6.00.00	**INSULATION**
6.01.00	Insulation material shall be tested for all mandatory tests only.

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6.02.00	As per relevant code/standard.
6.03.00	Thermal conductivity tests (for thermal insulation only) shall be done once in six months for insulation material manufactured during six months period for the same density and thickness of material as applicable as per IS: 3346 or equivalent standard.
7.00.00	**AIR FILTERS**
7.01.00	Pre/Fine filters shall be tested for initial and final pressure drop Vs flow and average synthetic dust weight arrestance as per the requirement of BS 6540/ASHARE-52-76/EN779. HEPA (Absolute) filters shall be tested as per applicable code.
8.00.00	**PIPES & FITTINGS**
8.01.00	All pipes and fittings shall be tested as per applicable codes / standard.
8.02.00	Site test Pipes shall be tested at site hydraulically/pneumatically as per application requirement.
9.00.00	**VALVES & SPECIALTIES**
9.01.00	Visual and dimensional check of valves as per relevant codes and approved drawing.
9.02.00	All the water line valves shall be hydraulically tested for body, seat and back seat (wherever provided) as per the relevant standard to which these valves are supplied irrespective of the working pressure for which these valves are selected. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure.
9.03.00	Valves shall be offered for hydro test and pneumatic test in unpainted condition.
9.04.00	Functional check of the valves for smooth opening and closing shall be done.
10.00.00	**AIR WASHER AND UNITARY AIR FILTERATION (UAF) SYSTEM (if applicable)**
10.01.00	Random 10% DPT on welds
10.02.00	Hydraulic test of pressure parts at 1.5 times the design. Pressure and water fill test of tanks shall be carried out.
10.03.00	Trial assembly of Air washer/UAF for one of each size shall be done in shop.

1.00.00 COMPRESSED AIR SYSTEM

1.01.00 AIR COMPRESSORS:

a) All pressure parts shall be hydraulically tested at not less than 150% of design pressure prior to painting and lining, if applicable. The test pressure will be maintained for 30 minutes.

b) All other parts including inter-connecting pipings shall be hydraulically tested wherever possible, as per relevant codes.

c) Ultrasonic testing shall be carried out on all forgings and shafts (if dia.>= 50mm) viz. Crank shaft, connecting rod, piston rod, etc. MPI/DP test will be done on machined areas of the above components.

d) Pistons shall be subjected to DP testing.

e) During assembly all clearances and alignments shall also be checked and recorded.

f) Rotor shall be statically and dynamically balanced.

1.01.01 PERFORMANCE TEST (SHOP TEST):

a) Performance test on the compressors shall be carried out in accordance with ISO: 1217/eq. The test shall also include demonstration of loading and unloading mechanism (Capacity control) and operation of safety valves.

b) Power consumption at motor input terminal at rated capacity as well as at fully unloaded condition of all the compressors shall be measured.

c) Vibration and noise level measurement will be done during shop performance test.

d) Test shall be carried out on all compressors with contract drive motor.

e) Clearance on Type test requirements from Employer's Engg. Shall be reviewed prior to final clearance.

1.02.00 INTAKE AIR FILTER & SILENCER

Test for Capacity, Pressure drop and Efficiency shall be done as per manufacturer's standard.

1.03.00 AIR RECEIVER, HEAT EXCHANGERS, MOISTURE SEPERATORS, AIR DRYING PLANT:

Each finished vessel shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.

NDT on weld joints shall be as per respective code requirements or the minimum as specified below:

(i) 100 % DPT on root run of butt welds.

(ii) 100% DPT on all finished butt welds and fillet welds

(iii) 10% RT on butt welds which shall include all T- joints.

Tube to Tube sheet joint of the heat exchangers shall be subject to Mock-up test as per the relevant standards.

Reactivation blowers shall be tested for FAD, temp. rise, noise & vibration. Rotating parts shall be dynamically balanced.

Completely assembled ADP shall be pneumatically tested at design pressure for a duration of 5 minutes. Functional and sequential operation testing of the completely assembled ADP shall be demonstrated at shop. Other accessories shall be tested as per relevant code and sections. Dew point measurement shall be done at site.

1.04.00 H.O.T. CRANE

a) Chain pulley Blocks shall be tested as per IS: 3832.

b) Following NDT requirements shall be met:

100% RT of Butt welds in tension and 10% RT of butt welds in compression.

DP at random on all weldments.

Deflection, load, overload & travel check on HOT crane assembly shall be carried out as per IS: 3177.

1.05.00 PIPINGS, VALVES, TANKS & VESSELS, FITTINGS AND OTHER SPECIALITIES

Refer relevant clauses as indicated in QA requirements in Fire protection system (Tech. Spec. Section VI, Part B Sub Section QM).

For welding of GI Pipes refer Cl. 1.08.00(b)(ii) of Fire protection system(QA requirement)-Sub section QM.

All forgings > 50 mm dia shall be Ultrasonic Tested irrespective of the type, size & rating of the valve.

PART-QA

SUB-SECTION-QE

(ELECTRICAL)

RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5602-003-9	TECHNICAL SPECIFICATION SECTION-VI

GENERATOR AND AUXILARIES (E1)

The manufacture and fabrication of the generators and other equipments shall be in accordance with best engineering practice and quality control at every stage.

Part assemblies of generators to the maximum possible extent shall be done and match-marked in the shop for convenience of site assembly.

Inspections and tests at the various stages (in-factory manufacturing, on-site erection and commissioning) covered by the following list are only indicative inspections and tests. The list shall be finalized as per Contractor's practices and particular design and technology, National, International standard. Definitive programme and procedures shall be finalized. Inspections and tests to be performed after final completion and during commissioning shall be included in the general commissioning programme.

1 – IN-FACTORY TESTS ON RAW MATERIAL AND SEMI-FINISHED PRODUCTS

Stator	Stator frame metal sheets	Visual check Chemical analysis Carbon equivalent value (proof of the good weldability of the steel sheets) Ultrasonic test for thickness of 40 mm and above Mechanical properties check (yield strength, ultimate tensile strength, elongation (5% over 5 x diameters) and Brinnell hardness)
Stator	Stator terminals	Visual check Dimensional check Tests as per relevant standard Insulation resistance measurement High voltage test
Stator	Stator slot wedges	Visual check Flexural strength at 25 and 150 °C
Stator	Corona protective tape	Dimensional check Check of thickness Check of composition Check of tensile force Check of tape elongation at break

		Surface resistivity measurement
Stator	Bar copper strand	Chemical analysis of the copper Check of mechanical properties of the copper Dimensional and profile check Measurement of the conductivity Measurement of insulation thickness Measurement of adherence of insulation Measurement of insulation break-down
Stator	Magnetic core lamination sheets	Chemical analysis Visual check of surface Test of adhesion of insulating-coating Check of deformations Stacking factor check Ageing test Specific loss measurement Check of insulation coating thickness Test of magnetic characteristics (losses and anisotropy) (1 out of 10000 sheets)
Stator	Insulation caps	Visual check Dimensional check High voltage test
Stator	Bars for magnetic core clamping bolts	Chemical analysis Ultrasonic examination Mechanical properties check Magnetic properties check
Upper and lower brackets	Metal sheets	Visual check Chemical analysis Carbon equivalent value (proof of the good weldability of the steel sheets) Ultrasonic examination Mechanical properties check

Thrust and guide bearings	Metal sheets	Visual check Chemical analysis Carbon equivalent value (proof of the good weldability of the steel sheets) Ultrasonic examination Mechanical properties check
Thrust bearing	Casted thrust collar	Visual check Chemical analysis Ultrasonic examination
Braking and jacking system	Brake and jacking jacks	Visual check Dimensional check Functional test Oil and air pressure tests
Thrust bearing	Forged or rolled thrust ring	Visual check Chemical analysis Ultrasonic examination
Rotor	Sliprings	Chemical analysis Visual check of surface Dimensional check Ultrasonic test Hardness test
Rotor	Interturn insulation for field coil	Visual check Test of material composition Test of tensile shear strength Test for ageing Effect of temperature test Effect of moisture test Test of breakdown voltage,
Rotor	Field coil copper	Visual check Dimensional check Chemical analysis

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		Hardness test Test of electrical conductivity
Rotor	Spider and hub frame metal sheets, pole end-plate metal sheets, rim end-piece metal sheets	Visual check Carbon equivalent valve (proof of the good weldability of the steel sheets) Chemical analysis Mechanical properties check Ultrasonic examination
Rotor	Bars for rim clamping bolts and pole clamping bolts	Chemical analysis Ultrasonic examination Mechanical properties check
Rotor	Rim lamination sheets and pole lamination sheets	Visual check Chemical analysis Visual check of surface Test of adhesion of insulating-coating Check of deformations Test of magnetic characteristics
Rotor	Brake ring metal segments	Chemical analysis Mechanical properties check
Upper and lower shafts	Forged cylinders for shafts	Chemical analysis Mechanical properties check
Upper and lower shafts	Bars for coupling nuts and bolts	Chemical analysis Ultrasonic examination Mechanical properties check
Common accessories	RTD's temperature sensors for stator core, stator winding, cold /warm air, bearing, cooling water, ready for shipping	Visual check Dimensional check Resistance curve test High voltage test
Common accessories	Heat exchangers (stator, guide and thrust bearings)	Visual check Dimensional check Pressure tests

2 – IN FACTORY TESTS DURING MANUFACTURING		
Stator	Stator bars, ready for shipping	Dimensional check Strand counting test Forming check Varnishing check Curing check Inter-strand insulation test Type tests as per VDE 0530 Partial discharge measurement High voltage test -AC (3Ur) or DC voltage1.6 x 3Ur) Accelerated ageing test of insulation (on two bars) Tg δ measurement Breakdown voltage test (on two bars- no flash over before 4 Ur)
Stator	Stator frame sectors, after final welding	Dimensional check Visual check of welds (100%) Liquid penetrant or magnetic particle test on required welds Ultrasonic or radiographic test on required welds Visual and cleanliness check
Stator	Stator frame sectors, ready for shipping	Visual inspection of sand blasting Visual inspection of corrosion protection Test of coating thickness of corrosion protection
Stator	Magnetic core laminations, after punching and deburring	Visual and dimensional check Burr check Coating thickness check
Stator	Magnetic core laminations, ready for shipping	Visual check of surface Measuring of varnish thickness

		Insulation resistance test (1 out of 10000 laminations)
Stator	coolers, ready for shipping	Visual check Dimensional check Cleanliness check Pressure test
Stator	Magnetic core clamping bolts, ready for shipping	Visual check Dimensional check In case of insulated bolts, insulation test Liquid pressure test Magnetic partial test
Rotor	Brush holder and slip-rings, ready for shipping	Visual check Dimensional check Electrical check High voltage test
Rotor	Rim laminations and poles laminations, after punching and deburring	Visual check Dimensional check
Rotor	Rim laminations, ready for shipping	Visual check of surface
Rotor	Poles laminations, ready for assembling of the poles	Visual check of surface
Rotor	Pole end-plates, pole end-pieces, ready for assembling of the poles	Dimensional check
Rotor	Spider and hub parts, after final welding	Dimensional check, Visual check of welds (100%) Liquid penetrant or magnetic particle test on non-penetrated corner welds Ultrasonic or radiographic test on butt welds and total corner welds Visual and cleanliness check

Rotor	Spider and hub parts, ready for shipping	Visual inspection of sand blasting Visual inspection of corrosion protection Test of coating thickness of corrosion protection
Rotor	Rim clamping bolts, ready for shipping	Visual check Dimensional check Liquid penetrant test Magnetic particle test
Rotor	Field coils completed, ready for assembling of the poles	Visual check Dimensional check Short-circuit between turns test Resistance measurement
Rotor	Pole clamping bolts, ready for assembling of the poles	Visual check Dimensional check Liquid penetrant test Magnetic particle test
Rotor	Poles, ready for shipping	Visual check Dimensional check Resistance measurement Insulation resistance test, before and after high voltage test High voltage test Short-circuit between turns test Pole impedance measurement Weight determination
Rotor	Brake ring	Visual check Dimensional check Liquid penetrant test
Brake and lifting system	Braking and lifting cylinders, ready for shipping	Dimensional check Air and oil pressure test Visual and completeness check
Upper and lower brackets	Upper and lower brackets	Dimensional check

	parts, ready for shipping	Visual check of welds (100%) Liquid penetrant or magnetic particle test on required welds Ultrasonic or radiographic test on required welds Visual and cleanliness check
Upper and lower brackets	Upper and lower brackets parts, ready for shipping	Visual inspection of sand blasting Visual inspection of corrosion protection Test of coating thickness of corrosion protection
Thrust and guide bearings	Thrust and guide bearings pads, ready for shipping	Dimensional check Check of the flatness of the thrust bearing pads Check of the roughness of the friction surface of the pads Check of bonding of bearing metal by ultrasonic and liquid penetrant tests
Upper and lower shafts	Upper and lower shafts ready for shipping	Visual check Dimensional check Liquid penetrant and magnetic particle tests (only on transition areas between parts presenting different diameters, especially corner radius areas of the flanges) Check of shaft runout Check of the roughness of the friction surface throughout guide bearing surface
Upper and lower shafts	Coupling bolts and nuts, ready for shipping	Visual check Dimensional check Liquid penetrant test Magnetic particle test
Thrust Bearing	Thrust collar and thrust ring, ready for shipping	Visual check Dimensional check Liquid penetrant test

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		Check of the flatness and of the roughness of the thrust ring friction surface Check of perpendicularity between thrust ring friction surface and vertical axis of the together assembled collar-ring Check of the roughness of the friction surface throughout the guide bearing surface
3 – ON-SITE TESTS DURING ERECTION		
Stator	Stator frame, after completion	Check of qualification of the welders employed for welding the various parts of the stator frame Dimensional check, Visual check of welds (100%) Liquid penetrant or magnetic particle test on required welds Ultrasonic or radiographic test on required welds Visual and cleanliness check Visual inspection of corrosion protection Test of coating thickness of corrosion protection
Stator	Stator magnetic core	Visual and dimensional check during stacking and after completion Insulation resistance test of core clamping bolts Core magnetization (flux density at rating) with (i) infrared camera inspection for stabilized hot spots and (ii) vibration frequency check of core clamping bolts Final retightening of clamping bolts Clamping bolts tightness check Insulation resistance test of core clamping bolts (again after final retightening)
Stator	Stator winding, before fitting of stator bars	Visual and dimensional check of stator slots

Stator	Stator winding, after installing the lower stator bars	Visual check Measurement of the bar-slot contact resistance of each bar Insulation resistance test of each bar, before and after high voltage test High voltage test of each bar
Stator	Stator winding, after installing of the upper stator bars	Visual check Measurement of the bar-slot contact resistance of each bar Insulation resistance test of each bar, before and after high voltage test High voltage test of each bar
Stator	Stator winding, during brazing of the stator bar connections	Check of qualification of the brazing welders employed for welding the various parts of the rotor hub and spider
Stator	Stator winding, after completion and installation In its pit/ works	Visual check Dimensional check Check of winding circuit Visual check of stator slot wedging Check of efficiency of radial wedging (at least 50% of the wedges): - if basic wedging, hearing mallet technique - if ripple spring wedging, check of the spring compression Insulation resistance measurement
Stator	Stator winding, after completion and installation in its pit / works	Tan δ measurement of each phase Resistance measurement of each phase Polarization index measurement of each phase Insulation resistance test , before and after high voltage test Partial discharge measurement Corona visual inspection High voltage test

Stator	Neutral and phase terminals	Visual and dimensional Insulation resistance measurement, before and after high voltage test High voltage test
Rotor	Laminated rim	Visual and dimensional check during stacking and after completion
Rotor	Hub and spider, after completion	Check of qualification of the welders employed for welding the various parts of the rotor hub and spider Dimensional check Visual check of welds (100%) Liquid penetrant or magnetic particle test on required welds Ultrasonic or radiographic test on required welds Visual and cleanliness check Visual inspection of corrosion protection Test of coating thickness of corrosion protection
Rotor	Rotor incl. upper shaft and slip-rings, after completion and just before lifting in the stator bore	Visual check Dimensional check Resistance measurement of rotor Measurement of impedance of rotor Polarity test Check of no localized temperature-rises by thermo vision Resistance measurement of interpole connections and of the connections between slip-rings and rotor winding Insulation resistance test, before and after high voltage test AC voltage equal distribution test High voltage test

Braking and jacking system	Braking and jacking system completion	Visual check Visual check of welds Functional test Oil and air pressure tests
Cooling system (stator and thrust and guide bearings), after completion		Visual check Visual check of welds Functional test Pressure test
Upper and lower brackets incl. sole plates, after completion		Dimensional check, Visual check of welds (100%) Liquid penetrant or magnetic particle test on required welds Ultrasonic or radiographic test on required welds Visual and cleanliness check Visual inspection of corrosion protection Test of coating thickness of corrosion protection
Common accessories	RTD's temperature sensors for stator core, stator winding, cold/warm air, bearing and cooling water, just before installing and after installing	Resistance test Insulation resistance test
4 – ASSEMBLY AT WORKS/ ON-SITE TESTS DURING MOUNTING OF GENERATOR		
		Bracket alignment Bearing adjustment and play check Bearing insulation Air gap adjustment Shaft alignment: axial position, centricity, true running, axial eccentricity Verification of equal load distribution on the thrust bearing pads

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		Leak test on oil circuit of the thrust and guide bearings Functional test of the braking and jacking system

5 – SHOP TEST / ON-SITE TESTS DURING COMMISSIONING

A. Phase sequence test

B. Measuring and recording of water flows in the various cooling circuits: stator cooling circuit, upper guide bearing cooling circuit (if any) and combined lower guide- and thrust bearing (if any). Water flows shall be measured through the water flow meters installed on each cooling loop

C. Recording of following characteristics curves: no-load (at various speed) ;symmetric three-phased short circuit (upto 110% of rated current) ; bipolar short-circuit

D. Efficiency and losses measurement

E. Stabilized runaway speed test

G. Maximum temperature rise test at continuous overload apparent power concerning the following temperatures:

- oil and babitt metal of guide bearings and thrust bearing
- magnetic core
- stator winding
- rotor poles (winding and pole shoes)
- damping winding
- air and water cooling system

H. Check of (i) equal distribution of the static and dynamic load on the thrust bearing pads (ii) total static and dynamic load on the pads

I. Vibration measurement at different regimes plus improvement of dynamic balancing of the entire shaft line balance if needed

J. Shaft voltage measurement

K. Voltage balance test

L. Current Balance Test

M. Following tests in operation without any harmful damage to the machine:

- guide bearings and the thrust bearing to be able to operate for 15 minutes at rated conditions without any water cooling auxiliaries
- guide bearings and the thrust bearing to be able to withstand a machine shutdown without any water cooling
- thrust bearing to be able to withstand a machine shutdown without any oil injection system
- generator to be able to run at continuous overload apparent power without one of the air-to-water exchangers

N. Load and pressure tests shall be carried out on braking and jacking system (i) under 1.5 time rated load (rated load = total weight divided by the number of jacks) for the oil-pressurized jacking chambers and 1.5 time the rated air pressure for the air-pressurized braking chambers.

O. Following inspections and tests shall be performed on the rotor at the end of the commissioning sequence:

- Visual check
- Resistance measurement of rotor winding
- Measurement of impedance of rotor winding
- Resistance measurement of inter-pole connections and of the connections between slip-rings and rotor winding
- Insulation resistance test

P. Following inspections and tests shall be performed on the stator at the end of the commissioning sequence:

- Visual check
- Stator winding partial discharge measurement
- Resistance measurement of each phase
- Polarization index measurement of each phase
- Insulation resistance test
- Partial discharge measurement
- Tan δ measurement
- Test on limiter
- Determination of control range

Note : Test Indicated at

5C: Bipolar short circuit.

5E: Stabilized runaway speed Test

5G: Temperature rise test at continuous overload apparent power shall be finalized based on prevailing site conditions.

Any other tests covered in main technical specification are also applicable.

1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalization for all item.

2) All major Bought out Items will be subject to NTPC approval.

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EXCITATION SYSTEM (E-1)

TESTS / ITEM/ COMPONENTS /PROCESS	As per IEC-146	As per applicable standards	Functional check	HV & IR Resistance	IEEE/ANSI-C37.18	IS-8084	As per specification	Dimensional and visual	HEAT RUN TEST	RESPONSE TEST	RIPPLE CONTENT
Filter Circuit,	Y							y			
Excitor field Breaker field discharge resistor			Y	Y							
Excitation Transformer		Ref Auxiliary Transformer Table									
Integrated Gate Commutated Thyristors		Y					Y				
Field breaker					Y						
Bus duct AC/DC				Y		Y					
Cooler system			YI				Y				
FINAL ACCEPTANCE TEST EXCITOR											
Excitation assembly				Y			Y	Y			
Complete Excitation system			Y	Y			Y	Y	Y	Y	Y

Y1- Hydro test at 1.5 times rated pressure

Note: Any other tests specified else where in the technical specification are also to be carried out.
1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalization for all item.
2) All major Bought out Items will be subject to NTPC approval.

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GENERATOR BUS DUCT & NG EQUIPMENT (E-3)

Attributes / Characteristics Items/ Components Sub Systems	Mechanical properties, Pressure Test, Chemical Composition		Routine Test as per relevant IS/IEC
Aluminum Casting	Y		
Insulator (EN 10204-3.1 B / CENELEC/ EN 50089)	Y		Y
SF6 Gas (IEC 600376)	Y		
Circuit Breaker Components (IEC : 60056 / 600129 / 60298 /60694 / ANSI / IEEE / EN 10204-3.1)			
a) Retainign Ring	Y		
b) Contact Pin	Y		
c) Tulip Contact	Y		
d) Arcing Ring	Y		
e) Heater Split Ring	Y		
f) Contact finger	Y		
Pole Frame DIN EN 25817 / 50976)	Y		
Enclsorue (DIN EN 13920 / 25817)	Y		
Surge Capacitor (IEC 60358)			Y
Control Cubilce (IEC 60056 / 60129 / 60298)			Y
Complete Assembly (IEC 60056 / 60129 / 60298 / 60694 /ANSI / IEEE)			Y

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Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents during QP finalization for all the items.
2. All major Bought Out Items will be subject to Owner's approval.
3. Any other tests mentioned in the equipment specification are also to be carried out.
4. The codes and standards mentioned in equipment specification is governing.

GENERATOR BUS DUCT & NG EQUIPMENT (E-3)

Attributes / Characteristics / Items/Components Sub Systems	Visual & Dimensional Checks	Electrical / Mechanical / Chemical Properties	WPS & PQR	NDT / DP / MPI / UT	Painitng Quality & Adhesion Test	Galvanising Test as per IS: 2629 / 2633 / IS: 6745	Electrical clearance & Creepage	Functional/Opeartional check	Make / Type Rating / Model / TC / General Physical Inspection	Trial Assembly at works.	Routine Test as per relevant standard
Enclosure / Cubicle	Y	Y		Y	Y						
Busbar Conductor/Flexible Connector & Disconnector Link	Y	Y									
Enclosure Sheet	Y	Y									
Galvanised Steel Structure & Plate	Y					Y					
Welding on Enclosure & Conductor joint	Y		Y	Y							
Seal-Off Bushing, Gasket, Silicagel Breather, CT, VT, Surge Capacitor & Arrestor, NGT, NGR, Elastomer Spring Head & Panel Mounted Items	Y							Y	Y		Y
Bus Bar Pressurisation System	Y							Y			
Complete Bus Duct & Cubicles	Y				Y					Y	Y
Complete NGR (IEEE-32)	Y				Y			Y			Y

Note:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents during QP finalization for all the items.

2. All major Bought out Items will be subject to NTPC approval.

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HT SWITCHGEAR (E-7)

ATTRIBUTES / CHARACTERISTICS → / ITEMS, COMPONENTS, SUB-SYSTEM ASSEMBLY ↓	Make, Type, Model, Rating & TC	Electrical Properties	Mechanical properties	Chemical Properties	Dimensions & Finish	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint shade, thickness, adhesion & finish	Functional Checks	HV & IR Test	Degree of Protection Routine test as per NTPC spec.	CB Operation timing check	All Routine Tests as per relevant standard
Aluminum Bus bar material (IS : 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar material (IS : 613)	Y	Y	Y	Y	Y		Y							
Bus bar Support Insulator	Y	Y	Y		Y		Y				Y			
HT Circuit Breaker (IEC-62271-100)	Y				Y	Y	Y			Y			Y	Y
HT Contactors (IS : 9046 / IEC 60470)	Y				Y	Y	Y			Y				Y
Protection & Auxilliary Relays (IS : 3231 / 8686)	Y				Y	Y	Y			Y				Y
HT CT's & PT's (IS : 2705 / 3156)	Y				Y		Y							Y
HT Fuses (IS : 9385)	Y				Y	Y	Y							
Surge Arrester (IEC : 99 –4)	Y				Y		Y							Y
LT Contactors (IS : 13947)	Y				Y	Y	Y			Y				
Control & Selector Switches (IS : 6875)	Y				Y	Y	Y			Y				
Indicating Meters (IS : 1248)	Y				Y	Y	Y			Y				Y
Indicating Lamps (IS : 13947)	Y				Y	Y	Y			Y				
Push Buttons (IS : 4794)	Y				Y	Y	Y			Y				
Control Transformer (IS : 12021)	Y				Y	Y	Y			Y				Y
LT Fuses (IS : 13703)	Y				Y	Y	Y							
Energy Meters (IS : 722)	Y				Y	Y	Y			Y				Y
Transducers (IEC : 60688)	Y				Y	Y	Y			Y				Y
Diodes	Y	Y				Y	Y			Y				
Terminal Blocks	Y	Y				Y	Y							

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Synthetic Rubber Gasket (IS : 11149 / 3400)	Y	Y			Y		Y							
Breaker Handling Trolley	Y				Y	Y			Y	Y				
HT Switchgear Panel IEC-62271-200)	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought Out Items will be subject to NTPC approval.

LT INDOOR TRANSFORMER (E-4)

Attributes / Characteristics / Items/Components Sub Systems	Visual & Dimensional check	Mechanical properties	Electrical strength	Thermal Properties	Chemical Properties	NDT / DP / MPI	Voltage Ratio, Vector Gorup & Polarity	Make / Type / Rating / Model /TC / General Physical Inspection	WPS & PQR	Routine Test as per relevant standard	Measurement of capacitance & tan delta between winding	Routine Test
Enclosure door, H.V. & L.V. Cable Box / Flange Throat	Y	Y						Y				
Copper Conductor	Y	Y	Y		Y							
Insulating Material	Y			Y	Y							
CRGO Lamination & Built Core	Y											
Bushing /Insulator (IS:2544 / 5621)	Y							Y		Y		
Gasket	Y							Y		Y		
Off-Circuit Tap Changer	Y							Y				
Core Coil Assembly	Y						Y					
Marshalling Box	Y									Y		
WTI, Thermister, Terminal Connector	Y							Y				
Welding									Y			
Complete Transformer (IS:11171 / IEC 60076)	Y										Y	Y

Notes: 1) This is an indicative List of test/checks. The manufacturer is to furnish a detailed Quality Plan indicating his practice and procedure along with relevant supporting documents during QP finalisation for all item.

2. All major Bought Out Items will be subject to NTPC approval.

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AUX. TRANSFORMER (E-5B)

Attributes / Characteristics / Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC / General Physical Inspection.	WPS & PQR	Routine Test as per relevant test	Routine Test
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y						
Conservator / Radiator / Cooler / Pipes	Y	Y					Y						
Copper Conductor (IS:191)	Y	Y	Y		Y								
Insulating Material	Y	Y	Y	Y	Y	Y							
CRGO Lamination & Built Core	Y	Y	Y		Y	Y							
Bushing / Insulator (IS:2544 / 5621)	Y	Y								Y		Y	
Gasket	Y				Y	Y		Y				Y	
Transformer Oil (IS:335 / IEC296)												Y	
Off-Circuit Tap Changer	Y									Y			
Core Coil Assembly & Pre-tanking	Y								Y				
Marshalling Box	Y	Y					Y					Y	
WTI, OTI, MOG, PRD, Breather, Terminal Connector, Bucholz Relay, Globe & Gate Valve,	Y									Y			
Welding (ASME Sect-IX)	Y										Y		
Complete Transformer (IS:2026/ IEC-60076)	Y												Y

Note: 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2) All major Bought Out Items will be subject to NTPC approval.

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LT SWITCHGEAR (E-7)

(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERIS-TICS ↓ → ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLIY	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Sheet Steel (IS : 513)	Y	Y		Y	Y		Y							
Aluminum Bus bar Material (IS : 5082)	Y	Y	Y	Y	Y		Y							
Copper Bus bar Material (IS : 613)	Y	Y	Y	Y	Y		Y							
Support Insulator	Y	Y	Y	Y			Y							
Air Circuit Breaker (IS: 13947)	Y	Y				Y	Y			Y	Y			Y
Energy Meters (IS : 13010, 13779)	Y	Y				Y	Y			Y				Y
Power & Aux. Contactors (IS : 13947)	Y	Y				Y	Y			Y				
Protection & Aux. Relays (IS : 3231)	Y	Y				Y	Y			Y				Y
Control & Selector Switches (IS : 13947)	Y	Y				Y	Y			Y				
CT's & PT's (IS 2705 / 3156)	Y	Y					Y							Y
MCCB (IS : 13947)	Y	Y					Y			Y				
Indicating Meters (IS : 1248)	Y	Y				Y	Y			Y				Y
Indicating Lamps (IS : 13947)	Y	Y				Y	Y			Y				
Air Break Switches (IS : 13947)	Y	Y				Y	Y			Y				
Control Terminal Blocks	Y	Y				Y	Y							

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ATTRIBUTES / CHARACTERISTICS → / ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLIY	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Fuse (IS 13703)	Y	Y				Y	Y							
Control Transformer (IS : 12021)	Y	Y				Y	Y			Y				Y
Push Buttons (IS : 4794)	Y	Y				Y	Y			Y				
Transducer (IEC : 60688)	Y	Y				Y	Y			Y				Y
MCB (IS : 8828)	Y	Y				Y	Y			Y				
Breaker Handling Trolley	Y	Y				Y			Y	Y				Y
Synthetic Rubber Gasket (IS : 11149)	Y	Y		Y	Y		Y							
LT SWITCHGEAR (IS : 8623)	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2. Makes of all major Bought Out Items will be subject to NTPC approval.

LT BUSDUCT (E-3)

ATTRIBUTES, CHARACTERISTICS → / ITEM, COMPONENTS, SUB SYSTEM ASSEMBLY ↓	Dimension & Surface Finish	Make, Type, Rating & TC	Electrical Properties	Mechanical Properties	Chemical Properties	Item to conform to relevant IS	WPS Approval, Welder Qualification	Weld Quality Check (DP test & x-ray Test)	Paint Shade, Thickness, Adhesion & Finish	Tightness by Torque measurement	Electrical Clearances	Galvanizing Test as per IS 2629/ 2633/ 4759	IR – HV – IR Test	Phase Sequence Check	Degree of Protection routine test as per NTPC spec.
Aluminum Sheets / Plates / Strips / Flexibles / tubes IS : 5082 / 737)	Y	Y		Y	Y	Y	Y	Y							
CRCA Flats / ISMC (IS 2062)	Y	Y		Y	Y	Y									
Neoprene / Synthetic Rubber Gaskets (IS 11149 / 3400)	Y	Y		Y	Y										
Rubber Bellows (IS : 3400)	Y	Y		Y	Y										
Support Insulator (BS : 2782, IEC : 660, IS : 10912)	Y	Y	Y	Y											
Galvanized Structure & GI Earthing Flat (IS : 2629 / 2633 / 4749)	Y	Y				Y						Y			
Space Heater & Thermostat		Y	Y										Y		
LT Busduct (IS : 8623 PART 2)	Y	Y				Y	Y	Y	Y	Y	Y		Y	Y	Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and Procedure along with relevant supporting documents.
2. Makes of all major Bought out Items will be subject to NTPC approval.

HT CABLES (E-11 & E-15)

Item / Components / Sub System Assembly \ Attributes / Characteristics	Make, Type, Rating & T.C	Dimension/surface finish	Mechanial properties	Chemical Composition	Spark Test(as applicable)	Curing Properties	Electrical properties	Hot Set Test/ Eccentricity & Ovality	Lay length & Sequence	Armour coverage, cross over looseness, gap between two wire	Sequential marking/surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal seability on outer sheath	Metallic (Cu) Screening (If applicable)	Anti termite coating on wooden drums	Constructional requirements feature as per NTPC specification	Routine & Acceptance Test as per relevant standard & NTPC specification	FRLS Test
Aluminium (IS-8130)	Y	Y	Y	Y			Y											
Semiconducting Compound	Y		Y			Y	Y											
XLPE Compound (IS-7098 Part-II)	Y		Y			Y	Y					Y						
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810(Part 58) ,IEC-60754 Part-1)	Y		Y									Y	Y					Y
Triple Extrusion & curing /Manufacturing of Core		Y			Y			Y	Y									
Copper Tape	Y	Y	Y				Y											
Polyster tape	Y	Y																
Armour wire/strip	Y	Y	Y															
Copper tapping	Y	Y					Y											
Inner sheath	Y	Y																
Armouring										Y				Y				
Outer Sheathing		Y									Y	Y	Y			Y		Y
Power Cable (Finished) (IS : 7098 Part II, IEC : 60332 (Part 3 Cat. B), IS-5831, ASTM-D2843, IS10810(Part 58) , IEC-60754 Part-1)	Y								Y	Y	Y	Y	Y			Y	Y	Y
Wooden drum(IS-10418) /Steel Drum		Y													Y			

Notes:
1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought Out Items will be subject to NTPC approval.

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ROUTINE TESTS

Routine tests shall be carried out on each drum of finished cables for all types & sizes.
Following shall constitute routine tests:

1) Conductor Resistance test

2) High voltage test

3) Partial discharge test **(for Screened cables only)**

ACCEPTANCE TESTS

Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 7098 Part 1I

A) For Conductor

1) Tensile Test
2) Wrapping Test
3) Resistance test

B) For Armour Wires / Formed Wires (If applicable)

1)	Measurement of Dimensions	
2)	Tensile Tests	
3)	Elongation Test	
4)	Torsion Test	For Round wires only
5)	Wrapping Test	
6)	Resistance Test	
7)	Mass of Zinc coating test	For G S wires / Formed wires only
8)	Uniformity of Zinc coating	For G S wires / Formed wires only
9)	Adhesion test	For G S wires / Formed wires only
10)	Freedom from defects	

C) For XLPE insulation & PVC Sheath

1) Test for thickness
2) Tensile strength & Elongation before ageing
3) **Hot set test** **(For XLPE insulation)**

D) For completed cables

1) Insulation resistance test (Volume resistivity method)
2) High voltage test
3 Partial discharge test **(for Screened cables only)**

E) Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:-

1) Tensile strength & elongation after ageing **on XLPE insulation and PVC outer sheath**

2) Thermal stability test **on outer sheath**

3) Oxygen index test **on outer sheath**

4) Smoke density rating test **on outer sheath as per ASTM –D 2843**

5) Acid gas generation test **on outer sheath as per IEC – 60754 (Part 1)**

6) Flammability test as per IEC-60332 - Part- 3 (Category- B) **on completed cable**

F) Following tests shall be carried on one length of each size of offered lot:

1) Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires

2) Measurement of Eccentricity & Ovality

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L.T POWER CABLES (E-11)
(1.1 KV PVC & XLPE CABLES)

Item / Components / Sub System Assembly / Attributes / Characteristics	Make, Rating, Type & TC	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Hot set test (XLPE)	Lay length / Sequence	Armour coverage, Cross over, looseness, Gap between two armour wire/strip	Sequential marking/surface finish /cable length	Tensile strength, elongation before & after ageing of insulation & outer sheath	Thermal Stability of insulation and outer sheath *	Anti termite treatment on wooden drums	Constructional / requirement as per NTPC Spec.	Routine and acceptance test as per Relevant Standard and NTPC specification	FRLS Test
Aluminum (IS-8130)	Y	Y	Y	Y	Y											
PVC Compound (IS-5831)	Y		Y		Y						Y					
XLPE Compound(IS-7098 Part-I)	Y		Y		Y		Y				Y					
FRLS PVC Compound(IS-5831) ASTM-D-2843/ ASTM-D-2863 IEC-754 Part-I	Y		Y								Y					
Armour wire/strip (IS-3975)	Y	Y	Y													
Insulated Core		Y				Y	Y					Y				
Laid up core		Y						Y								
PVC Inner sheath		Y														
Armouring		Y							Y							
Outer sheath		Y								Y	Y	Y				Y
Finish cable (IS-1554 & 7098 – Part-1) ASTM-D-2843/ IS 10810 (Part- - 58) IEC-754 Part-I Swedish Chimney SS 4241475 for (F3 category) Flammability test IEC-332 Part –3 Cat-B	Y	Y							Y	Y	Y	Y		Y	Y	Y
Wooden drum (IS-10418) / Steel drum		Y											Y			

Note: 1. This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the practice and procedure along with relevant supporting documents.

2. Not applicable for XLPE insulation

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	ROUTINE TESTS Routine tests shall be carried out on each drum of finished cables for all types & sizes. Following shall constitute routine tests:
1)	Conductor Resistance test
2)	High voltage test at room temperature

	ACCEPTANCE TESTS
	Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1 & IS 7098 Part-I
A)	**For Conductor**
1)	Annealing test — For copper conductor only
2)	Tensile test — For aluminium conductor only
3)	Wrapping test — For aluminium conductor only
4)	Resistance test
B)	**For Armour Wires / Formed Wires (If applicable)**
1)	Measurement of Dimensions
2)	Tensile Tests
3)	Elongation Test
4)	Torsion Test — For Round wires only
5)	Wrapping Test
6)	Resistance Test
7)	Mass of Zinc coating test — For G S wires / Formed wires only
8)	Uniformity of Zinc coating — For G S wires / Formed wires only
9)	Adhesion test — For G S wires / Formed wires only
10)	Freedom from defects
C)	**For PVC / XLPE insulation & PVC Sheath**
1)	Test for thickness
2)	Hot set test — For XLPE insulation only
3)	Tensile strength & Elongation before ageing
D)	**For completed cables**
1)	Insulation resistance test (Volume resistivity method)
2)	High voltage test **at room temperature**

E)	Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:-
1)	Tensile strength & elongation after ageing **on PVC / XLPE insulation and PVC outer sheath**
2)	Thermal stability test **on PVC insulation and outer sheath**
3)	Oxygen index test **on outer sheath**
4)	Smoke density rating test on outer sheath as per ASTM –D 2843
5)	Acid gas generation test on outer sheath as per IEC – 754 (Part 1)
6)	Flammability test as per IEC-332 - Part- 3 (Category- B) on completed cable
7)	Fire resistance test as per SS 4241475 (F3 Category) on completed cable
F)	Following tests shall be carried on one length of each size of offered lot:
1)	Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires

L.T CONTROL CABLES (E-11)
(1.1 KV PVC CABLES)

Attributes / Characteristics / Item / Components / Sub System Assembly	Make, Type, Rating, T.C	Dimension/surface finish	Mechanical Properties	Chemical Composition	Electrical Properties	Spark Test	Lay length/Sequence	Armour coverage, cross over, looseness, gap between two armour wire	Sequential marking/surface finish/cable length	Tensile strength, elongation before & after ageing of insulation &outer sheath sheath	Thermal stability of insulation and outer sheath	Anti termite treatment on wooden drums	Constructional feature as per NTPC Spec.	Routine & Acceptance test as per relevant standard & page 2 & 3 of this table	FRLS Test
Copper Conductor (IS-8130)	Y	Y	Y	Y	Y										
PVC Compound (IS-5831)	Y		Y		Y					Y					
FRLS PVC Compound IS-5831 ASTM-D-2843/ IS 10810 (Part-58) IEC-754 Part-1	Y		Y							Y					Y
Armour wire/strip (IS-3975)	Y	Y	Y												
Insulated Core		Y				Y	Y				Y				
Laid up core		Y					Y								
PVC Inner sheath		Y													
Armouring		Y						Y							
Outer sheath		Y							Y	Y	Y				Y
Finish cable (IS-1554- 1) ASTM-D-2843/ IS 10810 (Part-58) IEC-754 Part-1 Swedish Chimney: SEN SS 424-1475(F3 category) Flammability test IEC-332 Part-3 Cat-B	Y	Y						Y	Y	Y	Y		Y	Y	Y
Wooden drum(IS : 10418) / Steel drum		Y										Y			

.Note : 1. This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents.

CONTROL CABLE

ROUTINE TESTS

Routine tests shall be carried out on each drum of finished cables for all types & sizes.
Following shall constitute routine tests:

1) Conductor Resistance test

2) High voltage test at room temperature

ACCEPTANCE TESTS

Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 1554 Part 1

A) For Conductor

1)	Annealing test	For copper conductor only
2)	Resistance test	

B) For Armour Wires / Formed Wires (If applicable)

1)	Measurement of Dimensions	
2)	Tensile Tests	
3)	Elongation Test	
4)	Torsion Test	For Round wires only
5)	Wrapping Test	
6)	Resistance Test	
7)	Mass of Zinc coating test	For G S wires / Formed wires only
8)	Uniformity of Zinc coating	For G S wires / Formed wires only
9)	Adhesion test	For G S wires / Formed wires only
10)	Freedom from defects	

	C)	**For PVC insulation & PVC Sheath**
	1)	Test for thickness
	2)	Tensile strength & Elongation before ageing
	D)	**For completed cables**
	1)	Insulation resistance test (Volume resistivity method)
	2)	High voltage test at room temperature
	E)	Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:-
	1)	Tensile strength & elongation after ageing on PVC insulation and PVC outer sheath
	2)	Thermal stability test on PVC insulation and outer sheath
	3)	Oxygen index test on outer sheath
	4)	Smoke density rating test on outer sheath as per ASTM –D 2843
	5)	Acid gas generation test on outer sheath as per IEC – 754 (Part 1)
	6)	Flammability test as per IEC-332 - Part- 3 (Category- B) on completed cable
	7)	Fire resistance test as per SS 4241475 (F3 Category) on completed cable
	F)	Following tests shall be carried on one length of each size of offered lot:
	1)	Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires

CABLING, EARTHING, LIGHTNING PROTECTION (E-12)

ATTRIBUTES / CHARACTERISTICS / ITEMS/COMPONENTS / SUB SYSTEMS	Dimension	Paint shade, paint thickness, adhesion	Pre-treatment of sheet	IP protection	Proof load*	Surface finish	Deflection test*	HV & IR	Galvanise Test (If Applicable)	Functional	Bought out items/Bill of material	Routine tests as per relevant standard & specification	Acceptance tests as per relevant standard & specification	Constructional feature as per NTPC Specification
Wall Mounted-Lighting Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Switch box/junction box/ Receptacles Panel (IS-513, IS:5, IS:2629, 2633, 6745)	Y	Y	Y	Y		Y		Y	Y	Y	Y	Y	Y	Y
Cable glands(BS-6121)	Y											Y		
Cable lug(IS-8309)	Y											Y		
Lighting wire(IS-694)	Y											Y		
Flexible conduits	Y											Y		Y
Conduits(Galvanise & Epoxy) IS-9537 & IS-2629,2633 ,6745	Y		Y								Y	Y		Y
RCC Hume Pipe (IS-458)												Y		
Cable termination & straight through joint (VDE-0278)	Y											Y		Y
Cable Trays, Flexible supports system & accessories IS-513, 2629,2633,6745	Y		Y		Y	Y	Y	Y	Y	Y		Y	Y	Y
Trefoil clamp	Y													Y
GI flats for earthing & lighting protection (IS 2062, 2629, 6745,2633)	Y		Y						Y			Y		Y
GI wire (IS-280)	Y											Y		
Fire Sealing System (BS –476)												Y	Y	Y

Note:1. This is an indicative list of tests /checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.

2. Deflection Test on cable trays and Proof Load test on cable trays support system will be as per details given in the NTPC technical specification & approved MQP. The above acceptance tests shall be done only on one sample from each size of offered lot.

3. Make of all items will be subject to NTPC approval.

INDUCTION MOTOR & SYNCHRONOUS MACHINE (E-14)

TESTS/CHECKS / TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y					Y
Shaft	Y	Y	Y	Y	Y	Y			Y
Magnetic Material	Y	Y	Y	Y	Y		Y		
Rotor Copper/Aluminium	Y	Y	Y	Y		Y	Y		Y
Stator copper	Y	Y	Y	Y			Y		Y
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insulating Material	Y		Y	Y			Y		
Tubes for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	Y	Y	Y	Y	Y				Y
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y	
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y	
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y				Y
Wound stator	Y	Y					Y	Y	
Wound Exciter	Y	Y					Y	Y	
Rotor complete	Y	Y					Y		
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y		
Accessories, RTD, BTD, CT, Brushes, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.	Y	Y	Y						
Motor (IS 325 / 4722/ 9283)	Y	Y	Y						

INDUCTION MOTOR & SYNCHRONOUS MACHINE (E-14)

TESTS/CHECKS / ITEMS/COMPONENTS	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All tests as per IS-325/IS-4722 / 9283	Vibration	Over speed	Tan delta, shaft voltage & polarisation index test
Plates for stator frame, end shield, spider etc.									
Shaft									
Magnetic Material	Y		Y						
Rotor Copper/Aluminium									
Stator copper			Y						
SC Ring									
Insulating Material			Y						
Tubes for Cooler		Y							
Sleeve Bearing		Y							
Stator/Rotor, Exciter Coils									
Castings, stator frame, terminal box and bearing housing etc.									
Fabrication & machining of stator, rotor, terminal box									
Wound stator									
Wound Exciter									
Rotor complete				Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly									
Accessories, RTD, BTD, CT, Brushes, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.									
Motor (IS 325 / 4722 / 9283)						Y	Y	Y	Y1

Note : 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality

2. Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalisation. However, no QP for LT motor upto 50KW.

3. Makes of all major bought out items will be subject to NTPC approval.

Y1 = for HT Motor / Machines only.

DC SYSTEM (E-8)

LEAD ACID BATTERY								
ATTRIBUTES / CHARACTERISTICS → / ITEMS, COMPONENTS, SUB SYSTEM ASSEMBLY ↓	Dimensions & Finish	Conformance to relevant part drg. & Manufacturer's standards	Chemical composition	Lead Coating Thickness (min. 25 microns, IS: 6848 App.F) & Adhesion Check	Conformance to CPWD Spec. for Teak Wood	Paint Process checks, Paint Shade, Thickness, Adhesion & Finish	Constructional requirements as per NTPC Spec.	Routine & acceptance tests as per relevant standard
Container & Lids (IS : 1146)	Y	Y						
Vent Plugs	Y	Y						
Sealing Compound (IS : 3116)		Y	Y					
Positive & Negative Plates		Y	Y					
Separators (IS : 6071)	Y	Y						
Electrolyte (Water / Sulphuric Acid) (IS : 1069 / 266)		Y	Y					
Inter-cell Connectors & Fasteners	Y	Y		Y				
Battery Stand	Y	Y			Y	Y		
Cell Insulators	Y	Y						
Stack Assembly	Y	Y						
Lead Acid Battery (IS : 1652)	Y						Y	Y

Note: 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality.
2. Plan indicating the practice and procedure along with relevant supporting documents.

Ni- Cd BATTERY

ATTRIBUTES / CHARACTERISTICS → / ITEMS, COMPONENTS, SUB SYSTEM ASSEMBLY ↓	Dimensions & Finish	Impact Strength	Conformance to relevant part drg. & Manufacturer's standards	Resistance to Alkali	Chemical composition	Nickel Plating thickness	Paint Shade, Thickness, Adhesion & Finish	Routine & acceptance tests as per relevant standard
Container & Lids	Y	Y	Y	Y				
Vent Plugs	Y		Y	Y				
Perforated Steel Strips	Y		Y	Y		Y		
Active Material for Positive & Negative Plates			Y		Y			
Separators	Y		Y	Y				
Electrolyte			Y		Y			
Inter-cell Connectors & Fasteners	Y		Y	Y		Y		
Battery Stand	Y			Y			Y	
Cell Insulators	Y		Y	Y				
Stack Assembly	Y		Y					
Ni-Cd Battery (IS : 10918)	Y							Y

Notes:

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to NTPC approval.

BATTERY CHARGER

Attributes / Characteristics → / Items / Components / Sub- assembly	Make, Model, Type, Rating & Finish	Verification of Routine test reports as per relevant IS	Sheet Steel Pretreatment & Painting process checks	Conform to relevant Standard & NTPC spec	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features as per NTPC approved drgs & specification	Temperature Rise Test on one unit of each rating if Temperature rise test as a Type test witnessing is waived off	Ripple Content Test, Load Limiter & AVR Operation Test	Dynamic Response Test	Operational & Functional Checks	HV & IR Test	Burn-In Test at 50^C for 48 hrs in energised condition	Alternating current measurement test	Degree of Protection Test as per NTCP Spec.
Rectifier Transformer and Reactors IS : 4540, 2026)	Y	Y		Y			Y				Y			
Electronic Components including Potentiometer (Vernier Type)	Y			Y		Y								
Electronic Cards	Y			Y								Y		
PCB & racks for electronic cards	Y					Y								
Control & Selector Switches (IS : 6875)	Y			Y						Y				
Indicating Meters (IS : 1248)	Y			Y						Y				
Indicating Lamps (IS: 13947)	Y			Y						Y				
Air Break Switches / Fuses (IS : 13947 / 13703)	Y			Y						Y				
Control Terminal Blocks (IS : 13947)	Y			Y										
Control Transformer (IS : 12021)	Y			Y						Y				
Push Buttons (IS : 4794)	Y			Y						Y				
MCB (IS : 8828)	Y			Y						Y				
PVC insulated Copper control wires (IS : 694)	Y			Y										
Sheet Steel (IS : 513)	Y		Y	Y										
Synthetic Rubber	Y			Y										

Gaskets														
Annunciator	Y									Y		Y		
Battery Charger	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:
1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to NTPC approval.

BATTERY CHARGER
(of capacity upto 24 V / 48 V , 150 A DC)

Attributes / Characteristics → / Items / Components / Sub- assembly ↓	Make, Model, Type, Rating	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features as per approved drgs	Ripple Content Test, Load Limiter operation & AVR Operation Test	Operational & Functional Checks of aux. Devices like annunciator, switches, indiactors etc.	HV & IR Test	Environmental stress screening test	Dynamic response test	AC input current measurement test	Temperature rise test on one unit
Battery Charger	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note

1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Makes of all major Bought Out Items will be subject to NTPC approval.

Service Elevators (ELECTRICAL & MECHANICAL)
Passenger/ Service Elevators and Lifts

TESTS /CHECKS / Items	Material Test	DPI/MPI	Ultrasonic Test	Dimensions/Physical	Functional/ Operational Test/ Run Test	Performance Test	Other Tests	All routine tests as applicable standard	Plain shade, thickness & adhesion	Assembly/fit up	Travel speed
Shaft/ Rack/Gears	Y	Y	Y	Y							
Geared Machine					Y						
VVVF Panel				Y	Y		Y3	Y	Y		
Electrical motor				Y	Y			Y			
Complete Lift/ Elevator				Y	Y	Y1	Y2			Y	Y1
Leveling & Landing							Y1				
Safety Gear							Y1				
Door operations							Y1				

Y1 –TEST TO BE DONE AT SITE

Y2 - LOAD/OVERLOAD TEST TO BE DONE AT SITE AS APPLICABLE.

Y3 – Burn in test on electronic card

NOTE: 1. This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the applicable practices and procedures followed along with relevant supporting documents during QAP finalization.

2. Makes of all bought out items shall be subject to NTPC approval.

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STATION LIGHTING (E-6)

Item Components / Sub System / Assembly — Attributes / Characteristics	Make, Type , Rating/ TC	Dimension	Pre-Treatment of sheat	Paint Shade Adhesion & Finish Thickness	Galvanise Test	IP Test	Bought Out Items/ Bill of Material	HV & IR	Functional Check as per spec.	Constructional Feature as per NTPC spec.	Routine Test as per relevant std aad spec	Acceptance Test as per relevant std and spec	Item to conform to relevant standard
Luminaries (IS-10322 Part-5 Sec.1)	Y					Y		Y			Y	Y	
Electronic Ballast	Y										Y	Y	Y
Lighting Wire (IS-694)	Y										Y		
Fans (IS-374)	Y										Y		
Pole (IS-2713)	Y			Y						Y	Y	Y	
Lamps (IS-9800, IS-9974)	Y										Y	Y	
Lighting Mast (with raise & lower lantern type)	Y	Y			Y					Y	Y	Y	
Wall Mounted Lighting Panel (IS-513, IS-5)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Switch Box/ Junction Box/Receptacles/ Local Push Button Station, Lighting Panel (IS-513, 2629, 2633, 4759, 6745)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Cable Gland (BS-6121)	Y	Y									Y		
Cable Lug (IS-8309)	Y	Y									Y		
Flexible Conduit	Y										Y		
Lighting Transformer (IS-1117)	Y									Y	Y		
Epoxy & Galvanised Conduit (IS-9537, 2629, 2633, 4759, 6745)	Y	Y									Y		Y

Notes:
1 This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought Out Items will be subject to NTPC approval.

CONTROL PANEL (E-7)

Attributes Characteristics → / Item Components Sub System Assembly	Electrical Properties	Mechanical Properties	Chemical Properties	Dimensions / Finish	Type/ Rating/Functional check	HV/IR	Routine test as per relevant std.	Constructional Features	IS:6005 ,Seven tank process	Paint finish/ shade/thickness adhesion	Mountings / BOM/ Make, Completeness / Wiring	Interlock Functional & Operation Testing / Simulation check	Degree of Protection Test	Specification requirement
Sheet Steel (IS-513)		Y	Y	Y										
Aluminum / Copper Bus-bar(IS-5082/IS-613/IS-1987)	Y	Y	Y	Y										
Support Insulator (BS-2782/IEC-660/IS-10912)	Y	Y	Y	Y										
Control / Selector Switch(IS-6875)					Y	Y	Y							
Contractor/ MCB(IS-13947)					Y	Y	Y							
O/L Protection relays(IS-3231)					Y		Y							
C.T /V.T/ Indicating Meter(IS-2705/3156/1248)					Y	Y	Y							
Fuse/ Fuse carrier(IS-13703)					Y	Y	Y							
Terminals/lugs/pvc wires(IS-13947//IS-694)	Y			Y	Y	Y	Y							
Timers(IS-3231)					Y	Y	Y							
LVS, Mosaics														Y
Push Button/ Lamp/ (IS-6875)					Y	Y	Y							
Control Transformer (IS-12021)					Y	Y	Y							
Mimic, Annunciator					Y		Y							
GASKET(IS-11149)		Y	Y	Y	Y		Y							
Fabrication								Y						
Pretreatment & Painting									Y	Y				
Control panel										Y	Y	Y	Y	Y

NOTE:

1. This is an indicative list of Test/ Checks. The manufacturer to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. All major Bought Out Items will be subject to NTPC approval.

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DIESEL GENRATOR SET(E-9 & E-10)

DIESEL ENGINE

TESTS/CHECKS / ITEMS/COMPONENTS	Material Test	DP/MPI	UT(On forging and piston Bonding)	Balancing	Hydraulic/water fill test	Assy./fit up	Dimension	Functional/Operation test	Performance test as per BS-5514/or equivalent IS/ISO- Standard including Governing Test for 3 hors at full load and one hr at 10% overload	Fuel consumption, rated power measurement, rated speed	All other tests(if applicable) as per Spec./ relevant standard
Crank shaft	Y	Y	Y	Y							
Cylinder blocks/heads	Y				Y						
Liner/ Radiator	Y				Y						
Rotating/moving parts other than crank shaft	Y	Y									
Piston	Y	Y	Y								
Diesel Engine						Y	Y	Y	Y	Y	Y

Note: 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during QP finalization.
2. Make of all major BOIs will be subject to NTPC approval.

ALTERNATOR

ITEMS/COMPONENTS \ TESTS/CHECKS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All tests as per IS--4722	Vibration	Over speed	Tan delta, shaft voltage & polarisation index test
Plates for stator frame,end shield, spider etc.	Y	Y	Y	Y					Y									
Shaft	Y	Y	Y	Y	Y	Y			Y									
Magnetic Material	Y	Y	Y	Y	Y		Y			Y		Y						
Rotor Copper/Aluminium	Y	Y	Y	Y		Y	Y		Y									
Stator copper	Y	Y	Y	Y			Y		Y			Y						
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y									
Insulating Material	Y		Y	Y			Y					Y						
Tubes for Cooler	Y	Y	Y	Y	Y				Y		Y							
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y							
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y										
Castings, stator frame,terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y										
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y				Y									

ALTERNATOR

TESTS/CHECKS / ITEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All Routine tests as per IS-/IS-4722	Vibration	Over speed	Tan delta, shaft voltage & polarization index test
Wound stator	Y	Y					Y	Y										
Wound Exciter	Y	Y					Y	Y										
Rotor complete	Y	Y					Y						Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y											
Accessories, RTD, BTD, CT, AVR. Brushes, Diodes Space heater, antifriction bearing, cable glands, lugs, gaskets etc.	Y	Y	Y															
Alternator (IS 4722)	Y	Y	Y												Y	Y	Y	Y1

Note: 1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice Procedure along with relevant supporting documents during QP finalization.
2. Make of all major BOI will be subject to NTPC approval.
Y1= for HT Machines only.

FINAL ASSEMBLY

TESTS/CHECKS / ITEMS/COMPONENTS	Material Test	Dimension	WPS/PQR/Welding	NDT/DP/MPI/UT	Check completeness	Hydraulic/Leak/Pressure test	Functional Tests	All routine test as per Spec/ IS	No load test for one hour of the DG set assembly	Clearances & Alignment
Base frame	Y	Y	Y	Y	Y					
Fuel Tank	Y	Y	Y	Y	Y	Y				
Battery								Y		
Battery Charger								Y		
Control Panel								Y		
Assembled DG Set		Y			Y		Y		Y	Y

NOTES:
1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during finalization of QP.
2. Make of all major Bought Out Items will be subject to NTPC approval.

GENERATOR TRANSFORMER (E-5A)

Attributes / Characteristics / Items/Components Sub Systems	Visual & Dimensional Checks	Mechanical properties	Electrical strength	Thermal properties	Chemical Composition	Compatibility with oil	NDT / DPT / MPI / UT	Ageing Test.	Voltage Ratio, Vector Group & Polarity, Magnetic Balance Test	Make / Type / Rating / Model / TC ? General Physical Inspection.	10 kV Isolation test on core	WPS & PQR	Routine Test as per relevant standard	Vacuum & Pressure Test
Tank, H.V. & L.V. Cable Box / Flange throat	Y	Y					Y							Y
Conservator / Radiator / Cooler / Pipes	Y	Y					Y							
Copper Conductor (IS:191)	Y	Y	Y		Y									
Insulating Material	Y	Y	Y	Y	Y	Y								
CRGO Lamination & Built Core	Y	Y	Y		Y	Y								
Bushing / Insulator (IS:2544 / 5621)	Y	Y											Y	
Gasket	Y				Y	Y		Y						
Air Cell	Y													
Transformer Oil (IS:335)													Y	
On Load / Off-Circuit Tap Changer (IEC :214)	Y												Y	

Core Coil Assembly & Pre-tanking	Y								Y		Y			
Marshalling Box	Y	Y					Y							
WTI, OTI, MOG, Bucholz Relay, PRD, Thermister, Breather, Terminal Connector, Bushing CT, Fan & Pumps with Drives, Impact Recorder, Globe & Gate Valve, PD Detector, FRA and DGA Equipment										Y			Y	
Welding (ASME Sect-IX)	Y											Y		

Attributes / Characteristics / Items/Components Sub Systems	Oil Leakage Test	Jacking test followed by DP Test on load bearing Member	DGA of Oil for main tank and OLTC Chamber	Measurement of capacitance and tan delta	Partial Discharge measurement (long duration)as per IEC-76 clause No. 12.4	Temperature Rise Test	Routine Test	Nitrogen Dew Point Measurement before final packing on transformer at receipt at site.	Paint Shade Thickness and Adhesion & finish.
Complete Transformer (IS:2026 / IEC: 60076)	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note 1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents during QP finalisation for all items.

2) All major Bought Out Items will be subject to NTPC approval.

PART-QA

SUB-SECTION-QI

(CONTROL & INSTRUMENTATION)

1.00.00 **REQUIREMENTS OF AUTHORISATION-TO-SHIP-TEST (ATST) FOR SCADA**

1.01.00 Authorization-to-ship-test (ATST) or Factory acceptance test (FAT) shall include all required tests to fully demonstrate to Employer's satisfaction that each equipment/sub-system/system as well as software modules furnished as per this specification as well as SCADA as a whole, fully meets the functional, parametric and other requirements of this specification and Employer's approved drawings/documents under all operating regimes. The parametric requirements shall be as per SCADA specifications. All tests pertaining to Control System shall be applicable.

Contractor to note that ATST procedure given below in subsequent clauses are only indicative in order to help the Contractor in understanding the requirements and help him in submitting a detailed procedure based on these guidelines meeting all the specification requirements. These requirements are in addition to those stipulated against SCADA integrated testing.

1.01.01 The Authorisation-To-Ship-Test (ATST) shall include all reasonable exercises which the combination of equipment and software can be expected to perform. These tests shall be divided into, as a minimum, but not limited to the following categories:

(a.) Pre power on checks

(b.) Power on check

(c.) Hardware tests

(d.) Functional tests

(e.) Parametric tests

(f.) Power failure auto-restart tests

1.01.02 **Pre power on checks**

These tests shall include but not be limited to the following:

(a.) Visual Checks:

These tests will include checking of individual cubicles, peripherals, etc. for damages; proper inspection of cubicles, internal cabling, tuning, door arrangements, louvers, fans etc.

(b.) Hardware verification:

These tests will include verification of location of each card and module in Control System, HMIPIS, master clock systems, etc. Verification of no. of modules as per the approved BOM and corresponding layout drgs. on sub system basis. Verification of spare capacity in the cubicle for installation of new modules.

(c.) Verification of system technical documentation as per approved list.

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1.01.03 **Power on check**

To observe the start up and automatic loading initialization of software when system is energised .

1.01.04 **Hardware tests**

These tests shall include but not be limited to the following tests:

(a.) Verification of healthiness of all modules e.g., I/O modules, controller modules, processors, peripherals, etc.

(b.) System configuration:

(1.) Verification of system configuration with reference to approved configuration diagrams, communication controller, I/O redundancy, verification of multiple measurement scheme, HMIPIS configuration, etc.

(2.) Verification of features of complete SCADA like on line removal of I/O and controller modules, etc. in line with specification requirements.

(c.) Simulation of inputs:

To verify conversion calculations, scan rates, operator's functions, corrections of calculations. For simulation of inputs for I/O modules, this test will be carried out for 10% of each type of modules or min. 1 no. of each type, whichever is more.

(d.) Accuracy test:

Accuracy for analog inputs/ output shall be demonstrated for one of each type of analog card.

(e.) Demonstration of the manual and auto switchover from master to standby system bus, controllers, I/Os, processors etc.

(f.) Diagnostics Tests:

Complete on-line diagnostic tests on HMIPIS, individual peripherals, Control System, programmer stations, etc.

1.01.05 **Functional Tests**

The following tests shall be carried out on Contractor's SCADA.

(a.) Functional tests of CLCS:

(1.) Verification of proper signal acquisition, conditioning and distribution.

(2.) Verification of proper realisation of controller functions like bumpless transfer from auto to manual and vice versa (as stated above), functional checking of bias circuit (wherever provided), etc.

(b.) Functional tests of OLCS:

(1.) Verification of proper signal acquisition, conditioning and distribution.

(2.) Verification of proper realisation of logic functions, sequence control functions, running of complete start up program sequence in all modes of operation, shut down program, etc.

(3.) Verification of logic computation in controller by simulating inputs.

(c.) Functional tests for HMIPIS

(1.) Verification of all types of displays, logs including their formats, bar graphs, X-Y plots etc. Verification of all function keys on keyboards and availability of all operator functions.

(2.) Verification of event generation and handling capabilities of HMIPIS processors by simulating various types of events/data and observing associated event sequence display and alarm signalling boxes.

(3.) Calculations:

All calculations shall be tested on sample basis to demonstrate that these are in accordance with the specification and Employer's input as applicable. The Contractor shall prepare tests cases for calculations for proper verification for the features required for each type of computations.

(4.) Checking historical storage and retrieval functions including long term storage.

(5.) Verification of all programmer's stations functions for HMIPIS and Control System, as well as for documentation facility as specified.

(6.) For SER function, verification of resolution of SOE inputs, time synchronisation with master clock, data base modification, SOE report, printout, off-line & on line diagnostic features etc. For this purpose a test-simulator to generate sequences of 1 ms resolution for 100 points distributed in different panels shall be made available during testing.

(7.) Testing of each peripheral viz., CRTs, printers, hard disk drive, floppy drive, etc.

(8.) Testing of power supply system to SCADA, tolerance of SCADA w.r.t. voltage & frequency limits as specified, performance of SCADA with power supply break as specified.

(9.) Verification of switchover of main processor/controller to stand by processor/controller.

(10.) Verification of spare capacity w.r.t. spare wired-in space in cabinets/ cubicles, terminal blocks, peripherals, etc. in line with spec. requirements as stipulated under scope of work.

1.01.06 **Parametric tests**

Following tests shall be carried out to test Contractor's SCADA w.r.t. specification requirements.

(a.) For control system :

(1.) CPU loading

(2.) Cycle time/controller reaction time.

(3.) Memory spare capacity

(b.) For HMIPIS

(1.) CPU loading

(2.) Spare duty cycle

(3.) Spare memory capacity

(c.) Spare duty cycle for system bus

(d.) Various display response time

(e.) System accuracy

(f.) Demonstration of system reliability

(g.) Display update time on OWS CRT/LVS

1.01.07 **Power failure auto restart test**

Verification of availability of all system functions automatically after restoration of power after power failure to SCADA. Verification of restoration of all data which was stored in the system at the time of power loss.

1.01.08	The Contractor shall submit a detailed ATST procedure for Employer's approval during detailed engineering stage based on the above guidelines. The ATST procedure to be submitted by the Contractor shall be detailed and exhaustive enough such that Employer is satisfied that all the SCADA System specification requirements and features are being tested and the system meets these requirements. The test results obtained shall be properly documented by the Contractor and furnished in the Employer approved format as decided during detailed engg. And submitted in the requisite no. of copies with all annexures irrespective of the fact that Employer's representative was present during the tests.
1.01.09	The following minimum criteria shall be followed during all tests:
1.02.00	**Integrated Test Set-Up** For integrated testing of the total SCADA system, the Contractor shall employ a test set up PC based I/O simulator, which will capable of I/O signals in requisite manner. It is preferable to adopt soft signal simulating device to avoid cumbersome process of physical connection of I/O through potentiometer, switches, Lamps/LED's etc. The exact configuration/ set up shall be as finalized during detailed engineering.
1.02.01	Pulling out or insertion of any I/O module from its slot, shall not result in any system/subsystem failure.
1.02.02	The Contractor is to submit Authorisation-To-Ship-Test (ATST) procedure as a part of "Draft QA Programme fully meeting the intent and requirements of above and other applicable clauses of this specification. Since, the exact definition & extent / parameters of ATST can be finalised only when the engineering of SCADA has been finalised to a great extent, it is required that the detailed draft ATST procedure be submitted by the Contractor at a latter date as intimated by the Employer during engineering stage for Employer's comment and finalisation. Contractor shall incorporate all modifications, additions/ deletions to the ATST procedure as indicated by the Employer. The ATST shall be conducted as per Employer approved procedure for ATST which will be included in the approved "QA Programme". The Employer reserves the right to ask the Contractor to conduct any other test also during the ATST which may be required to fully satisfy the Employer regarding full compliance with specification requirements. Contractor shall conduct all such tests also within the quoted lumpsum price for this contract.
1.02.03	The results of all ATS Tests shall be properly documented by the Contractor and submitted to Employer in requisite number of copies with all annexures.
1.02.04	Following the tests, if in the opinion of the Employer, the system has not been adequately manufactured, programmed, tested or debugged the Contractor shall make good all deficiencies including system parametric specifications of display response time, processor duty cycle, SOE resolution, etc., and re-run the test to fully satisfy the Employer regarding full compliance with specification requirements and requisite quality standards.
1.02.05	The system shall not be shipped without approval of Employer in writing.

1.02.06	Upon successful completion of Authorisation-To-Ship Test, the Employer will provide the Contractor with a written Authorisation for shipment of the system equipment to the project site.
1.02.07	All final documentation as per requirement of this specification shall be available at the time of Authorisation-To-Ship-Test and this shall be dispatched alongwith the equipment in required number of copies.
1.02.08	Contractor shall note that no payments towards dispatch of equipment and subsequent activities shall be due and payable to the Contractor till the Contractor is able to successfully demonstrate to Employer's satisfaction that the SCADA and parts thereof fully meet the Authorisation-To-Ship Test requirements.

SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM (SCADA)

TESTS / ITEMS	Review of Pre ATST Report (R)	Pre Power on Check (R)	Dimensions, layout, Make of components, Electronic earthing (R)	Signal flow check in the Cubicles (R)	Internal cabling/Wiring (R)	Tuning (R)	Door Arrangement Locking (R)	Louvers, Fans (R)	HV/ IR on wired panels (R)	Illumination, Paint Shade, Thickness (R)	Hardware as per BOM (R)	Spare Capacity in Cabinet For New Modules (R)	System configuration as per approved documents (R)	Current/ Power Consumption (A)	Power Supply variation effect (A)	ms resolution, time stamping, view and printing of SOE log (R).
SCADA																
Integrated System	Y	Y	Y			Y			Y		Y		Y			
SCADA CUBICLES	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
MMI	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	
Programmer Station	Y		Y	Y	Y											
Peripherals	Y		Y													
Sequence of Event recorder	Y		Y													Y

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

7.6

SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM (SCADA)

TESTS / ITEMS	Healthiness of all modules (R)	Healthiness ,functional check for Peripherals (R)	Verification of System configuration(R)	On Line Removal of I/O modules. (R)	On line removal of controller modules (R)	Accuracy & repeatability test of analog cards (R)	Burn In and Elevated temp. test (R)	Diagnostic tests. (R)	Simulation of inputs (R)	Functional tests (signal acquisition , conditioning distribution controller functions)verifications of loop/logic functions. Bumbles transfer of A/M station response time of loops (A) Thickness (R)	Response time for displays (A)	Verification of Displays Logs, Format, graphs, Plots (R)
SCADA												
Integrated System			Y	Y		Y				Y	Y	Y
SCADA CUBICLES	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y
MMI	Y	Y		Y	Y	Y		Y	Y	Y	Y	Y
Programmer Station	Y	Y						Y				
Peripherals	Y	Y						Y				
Large video screen	Y	Y										

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM (SCADA)

ITEMS \ TESTS	Calculations (R)	Event handling SOE, alarm functions (R)	Historical Long term Storage & retrieval functions (R)	Redundancy of Controller (R)	Redundancy of Processor (R)	Redundancy of Power Supply (R)	Spare Memory Capacity (R)	CPU Loading Duty Cycle (R)	Redundancy of System Bus (R)	CRT up Date Time (R)	Power Failure Auto Restart (R)	System Accuracy (A)	Engineers / Programming functions (A) Redundancy of other devices as defined on spec.	Time synchronization (A)
SCADA														
Integrated System	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CLCS & OLCS				Y	Y	Y	Y	Y	Y		Y	Y		
MMI	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Programmer Station									Y		Y			

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

HYDROTURBINE RELATED SPECIFIC INSTRUMENTATION AND CONTROL

TEST/ATRIBUTES CHARACTERISTICS / ITEM	Linearity (R)	Frequency Response(R)	Calibration with simulated output.(R)	Spectrum(Harmonic Analysis (A)	Predictive Analysis Functions (A)	Storage & Comparative analysis of vibration (A)	Generation/analysis of plots (A)	Simulation test & generation of operator guidance (A)
HYDRO GENERATOR/ VIBRATION MONITORING SYSTEM								
Proximeter	Y	Y						
Acclerometer	Y	Y						
LVDT	Y							
Monitor for VMS	Y		Y*					
Overall System				Y	Y	Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Burn Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supplying documents.

* applicable for monitor electronics

CONTROL DESK, PLC PANEL, SMOKE DETECTOR, FIRE ALARM CONTROL PANEL

ITEMS \ TESTS	Visual ®	GA, BOM ,Lay Out of components ®	Dimensions ®	Paint Shade/Thickness/Adhesion ®	Alignment of Section ®	Component Rating/ Make / Type ®	Wiring ®	IR & HV ®	Review of TC for instruments/ Devices/ Recorders, Indicators/ osaic Items/ Transducers ®	Accessibility of TBS/ Devices ®	Illumination ®	Functional Check for Control Element, Annunciation	Mimic ®	Test as per IEC 1131 ® *	Test as per Std ® & (A)
1. Annunciation, Control, PLC Panel, Fire alarm panel	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y	Y
2. Smoke Detectors (UL-268,EN-54 PT-7), Heat Detectors (UL-521/EN 54 PT-5) Annunciation/ Control Panel (UL -864, EN-54, PT-2)															Y

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of test/ checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and Procedure alongwith relevant supporting documents.

- *Applicable for PLC
- Y - Test Applicable , ® - Routine Test (A) - Acceptance Test

Attributes / Characteristics → / Items / Components / Sub- assembly ↓	Make, Model, Type, Rating & Finish	Chemical & Mechanical Tests	Sheet Steel Pretreatment & Painting process checks	Conform to relevant Standard	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features of Battery Charger as per NTPC specification	Temperature Rise Test	Dynamic Response Test	Ripple Content Test, Load Limiter & Annunciator & AVR Operation Test	Operational & Functional Checks	HV & IR Test	Environmental stress screening test at 50^C for 48 hrs	Degree of Protection Test as per NTPC Spec.
BATTARY CHARGER													
Rectifier Transformer (IS : 2026)	Y			Y			Y				Y		
Electronic Components including Potentiometer (Vernier Type)	Y			Y									
PCB & Electronic Cards	Y			Y									
19" standard racks for electronic cards	Y					Y							
Control & Selector Switches (IS : 6875)	Y			Y						Y			
Indicating Meters (IS : 1248)	Y			Y						Y			
Indicating Lamps (IS: 13947)	Y			Y						Y			
Air Break Switches / Fuses (IS : 13947 / 13703)	Y			Y						Y			
Control Terminal Blocks(IS :13947)	Y			Y									
Control Transformer (IS : 12021)	Y			Y						Y			
Push Buttons (IS : 4794)	Y			Y						Y			
MCB (IS : 8828)	Y			Y						Y			
PVC insulated Copper control wires (IS : 694)	Y			Y									
Sheet Steel (IS : 513)	Y	Y	Y	Y									
Synthetic Rubber Gaskets	Y	Y		Y									
Annunciator	Y									Y		Y	
Battery Charger	Y				Y	Y	Y	Y	Y		Y	Y	Y

Notes:
1. Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions
2. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the Practice and procedure along with relevant supporting documents.
3. Makes of all major Bought Out Items will be subject to the Employer's approval.

POWER SUPPLY SYSTEM

ITEMS \ TESTS	Visual/dimension/rating/ Paint Adhesion/ Thickness (R)	General arrangement/BOM/make of components /Mimic ®	Efficiency ,regulation(R	Input voltage variation (A)	Out put voltage and frequency adj.range(A)	Premilinary light load test(R)	Load transfer retransfer test (R) *	AC input faliure and return test (R)	Parralel operation and current divison(R)	Relative harmonic content(R)	Restart with PRI A.C and battery (separately)(R)	System transfer and retransfer (R)*	Asynchronous transfer(R)	Ripple content(R)	Load limiter operation (R)	IR/HV(R)	Tests as per standard &specification (R)&(A)
UPS/CONVERTER	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
VOLTAGE STABILISER	Y	Y	Y	Y	Y					Y		Y				Y	
LEAD ACID BATTERY(TUBLA)-IS-1651																	Y
LEAD ACID BATTERY (PLANTE)-IS-1652																	Y
NICKEL CADMIUM BATTERY(IS-10918/IEC-623)																	Y

R-Routine Test A- Acceptance Test Y – Test applicable

* Transfer time and Over shoot /under shoot during load & system transfer shall be recorded .

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

INSTRUMENTATION CABLE

TESTS / ITEMS	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®
1. Instrument cable twisted and shielded															
Conductor(IS-8130)	Y			Y			Y								
Insulation(VDE-207)				Y	Y	Y	Y						Y		Y
Pairing/Twisting				Y	Y		Y								
Shielding				Y			Y			Y					
Drain wire	Y			Y			Y		Y	Y					
Inner Sheath				Y	Y	Y	Y					Y	Y		
Outer Sheath				Y	Y	Y	Y					Y	Y		
Over all cable	Y	Y	Y	Y	Y		Y	Y			Y			Y	
Cable Drums(IS-10418)				Y			Y								

Note : High Temp. cables shall be subjected to tests as per VDE-207 (Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.

Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all item.

Note : ® - Routine Test A - Acceptance Test Y - Test Applicable

Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)

- * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)
- ** Characteristic Impedence, Attenuation, Mutual Capacitance, Cross Talk (As applicable)

\+ Sample size will be One No. of each size/type per lot.

++ Sample size will be One No. sample for complete lot offered irrespective of size/type.

CLOSED CIRCUIT TELEVISION SYSTEM (CCTV)

Attributes Characteristics / Item Components Sub System Assembly	Make, Model, Type, Rating, TC®	Dimension/constructional requirement®	Functional/operational check®	Switching capability and sequence®	No. of inputs/outputs, display®	Provision for connectivity with the LVS®	Pan range/speed, tilt/tilt speed®	Operational check from key board/control panel®	Commands from Video switcher/control unit®
Video Switcher/control system	Y		Y	Y	Y	Y			
Key boards	Y		Y						
Cameras	Y	Y	Y						
Lens	Y	Y	Y						
Camera Housing	Y		Y						
Pan & Tilt unit	Y	Y	Y				Y		
On site receiver	Y		Y						
Monitor	Y	Y	Y						
Video Recorder	Y		Y						
Video Amplifier	Y		Y						
Complete System	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note : 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of test/checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents.

R –Routine Test Y -Test Applicable

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MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

ITEMS \ TESTS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y	
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y	
3. Pr./D.P.Switch (BS-6134)	Y	Y	Y	Y	Y	Y
4.Electronic Transmitter (IEC-770)	Y	Y	Y	Y	Y	Y
5. Temp. Switch	Y	Y	Y	Y	Y	Y
6. Recorder (IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y
7. Vertical indicators	Y	Y	Y	Y		Y
8. Digital Indicators	Y	Y	Y	Y		Y
9. Integrators	Y	Y	Y	Y		
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y
12. Thermocouples (ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y
13. RTD (IEC-751)	Y	Y	Y	Y	Y	Y

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

TESTS / ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
14. Thermowell									Y	Y	Y
15. Cold junction compensation box	Y	Y	Y	Y				Y			
16. Orifice plate (BS-1042)	Y	Y	Y	Y *	Y	Y **	Y **		Y	Y **	Y
17. Flow nozzle (BS-1042)	Y	Y	Y	Y *	Y	Y	Y		Y	Y	Y
18. Level transmitter/ switch	Y	Y	Y	Y				Y	Y	Y	Y
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.											
** If applicable											

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted alongwith relevant supporting documents.

PUBLIC ADDRESS SYSTEM

TESTS / ITEMS	Test as per standard (A)	Service feature like call station /party identification, page communication, communication between zones etc.(A)	System band width (A)	Effect of input voltage variation (A)	Regulation of output (A)	HV/IR(R)
Public address system *						
Hand Set Stations (IS-9302 Part-III) /IEC-268-3	Y					
Amplifiers (IS-9302 Part-II)/ IEC-268-2	Y					
Loud Speaker (IS-9302 Part-IV) /IEC-268-3	Y					
Power Supplies				Y	Y	Y
Central Exchange			Y	Y		
Overall System		Y				
EPABX As per (DOT/TEC)/Spec	Y					

R-Routine Test A- Acceptance Test Y – Test applicable

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER

Test/Attributes / Characteristics / ITEM/ COMPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator ®	EPT output ®	Grease leakage ®	Local/ Remote (Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER (IS_9334)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Note: 1) Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions

2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.

® - Routine Test (A) - Acceptance Test Y - Test applicable

MAINTENANCE AND CALIBRATION EQUIPMENT

Item \ Test/Attributes Characteristics	Make, Model, Type and Rating ®	Functional check®	Temp Stability Test (A)	Calibration®
Maintenance Calibration equipment				
Electronic test bench	Y	Y		Y
Dead Weight tester	Y	Y		Y
Vacuum tester	Y	Y		Y
Hydraulic Pressure gauge Tester	Y	Y		Y
Portable Pressure calibrator	Y	Y		Y
Secondary standard quality pressure Gauge	Y	Y		Y
Portable Electro Pneumatic Calibrator	Y	Y		Y
Portable Millivolt calibrator	Y	Y		Y
Resistance Thermometer Bridge	Y	Y		Y
Decade Resistance Box	Y	Y		Y
Portable thermocouple/RTD Calibrator/Simulator	Y	Y		Y
Portable Multifunction Counter	Y	Y		Y
Power pack	Y	Y		Y
RCL Bridge	Y	Y		Y
Portable Infrared Thermometer	Y	Y		Y

Note:

1. Detailed procedure of Environmental stress screening test shall be as per Quality Assurance Programme in General Technical Conditions
2. This is an indicative list of tests/checks. The manufacturer is to furnish a check lists for final inspection indicating the practices and procedure adopted along with relevant supplying documents.
3. Other Maintenance & Calibration equipment shall be checked for functional and calibration (as applicable).
4. Calibration to be done with the instrument having better accuracy than the item under test and whose calibration shall be traceable to International Standard.

® Routine Test, (A) Acceptance Test, Y - Test applicable

SECTION: I

SUB-SECTION: C3

TECHNCIAL SPECIFICATION

(ELECTRICAL PORTION)

TECHNICAL SPECIFICATION

FOR

HVAC

(ELECTRICAL PORTION)

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
c) Supply of mandatory spares as specified in the specifications.
d) Erection and Commissioning spares.
e) Erection & Maintenance tools & tackles.
f) Electrical load requirement for HVAC.
g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
h) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer /BHEL approval without any commercial and delivery implications to BHEL
i) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
j) Motor shall meet minimum requirement of motor specification.
k) LT switchgear panels shall meet minimum requirement of LT switchgear specification.
l) LT power & control cables shall meet minimum requirement of LT power & control cables specification.
m) Cabling, earthing & lightning protection shall meet minimum requirement of cabling, earthing & lightning protection specification.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/ No deviation certificate. In line with this two signed and stamped copies of the following shall be furnished by the bidder as technical offer:

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a) A copy of "Annexure-I to Section-C: Standard Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.

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3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature etc. is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4. List of enclosures:

a) Electrical scope between BHEL & vendor.

b) Annexure-A: General Electrical Specification

c) Annexure-B: Technical specification, datasheets, NTPC Quality assurance & Inspection and quality plans for 415V Electric motors.

d) Annexure-C: Technical specification, datasheets, NTPC Quality assurance & Inspection and quality plans for 415V LT Switchgear.

e) Annexure-D: Technical Specification, datasheets, NTPC Quality assurance & Inspection and quality plans for LT power & control cables.

f) Annexure-E: Technical Specification, datasheets, NTPC Quality assurance & Inspection and quality plans for cabling, earthing & lightning protection.

g) Electrical Load data format.

5. For LT Swgr. details refer Annexure-X.

6. LT Swgr. schematics shall be finalized during detailed engineering.

7. List of sub-vendors shall be as per Annexure-F

8. List of mandatory spares is as per Annexure-Y

9. Drawing document submission schedule shall be as per Annexure-Z

10. QAP submitted with this specification shall be submitted by successful bidder without any change in the content & format. However, approval of QAP during detailed engineering shall be subjected to customer acceptance of the same and any minor change shall be without any commercial implication to BHEL.

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PACKAGE: HVAC (CIVIL IN CUSTOMER-SCOPE)

PROJECT: 3X40 MW RAMMAM HEP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	Vendor	Vendor	1. 415 V AC/240 V AC supply shall be provided by Vendor
2	Local Push Button Station (for motors)	Vendor	Vendor	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in vendor's scope b) one end equipment in vendor's scope	 Vendor Vendor	 Vendor Vendor	1. Finalisation of cable sizes shall be done by Vendor meeting specification requirements. Vendor shall provide lugs & glands accordingly. 2. Laying of cables by Vendor. 3. Termination at equipment terminals by Vendor.
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	
5	Cable trays, accessories & cable trays supporting system	Vendor	Vendor	
6	Cable glands and lugs for equipments supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537. Makes of conduits shall be subject to customer approval at contract stage.
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	Vendor	Vendor	
10	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer approval at contract stage.
11	Mandatory spares	Vendor	-	Vendor to quote as per specification.
12	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
13	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing & cable routing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies.

ANNEXURE – I TO SECTION – C : STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR
PACKAGE: HVAC (CIVIL IN CUSTOMER-SCOPE)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipments requiring cabling, and shall incorporate cable trays routing details. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

ANNEXURE-A

CLAUSE NO.	GENERAL ELECTRICAL SPECIFICATION (E0)
1.00.00	**GENERAL REQUIREMENTS**
1.01.00	a) For the purpose of design of equipment/systems, an ambient temperature of 40 deg. Centigrade max and relative humidity of 95 % shall be considered.
	b) All equipment shall be suitably designed and treated for normal life & satisfactory operation under conditions prevalent at site. The equipment and each part of it shall be strong enough and sufficiently well connected to resist total operating stresses, including stresses resulting from an earthquake in any horizontal direction.
	c) The equiments shall be designed to withstand seismic forces.
1.02.00	All equipments shall be suitable for rated frequency of 50Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification. The step-up voltage level for the project shall be 132 KV. Each generating unit will be connected to its own step-up transformers for feeding power into the EHV grid. The overall system shall be designed considering maximum voltage variation of +/- 5% and fault level of 31.5KA for 132 KV system.
1.03.00	Contractor shall provide fully compatible electrical system, equipments, accessories and services for the entire station/plant in his scope as well as those specifically required by the Employer.
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and International Codes & Standards, especially the Indian Statutory Regulations.
1.05.00	The auxiliary AC voltage supply arrangement shall have 3 phase 415V, 240V AC single phase and 220V DC systems. System shall be designed to limit voltage variations as given below under worst operating condition: a) 33KV/11KV/415V/240 V +/- 10% b) 220V DC +10%, -15%
1.06.00	The voltage level for motors shall be 3 phase, 415V AC
1.07.00	The AC control supply voltage shall be 110 V.
1.08.00	Fault level shall be limited to 45kA RMS for 415V system.
1.09.00	The nominal voltage of main DC system shall be 220V. In addition, the contractor may propose 48V or 24V systems as per requirements of control and instrumentation of his equipment and design.
1.10.00	The contractor shall furnish calculations of maximum loading and fault levels under the most onerous conditions for the various equipment/systems to prove adequacy of their parameters. In case any equipment or system is found to be inadequate, it shall be changed/ modified without any additional liability to the Employer.

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1.11.00	Transformer voltage ratios, taps, impedances and tolerances thereon, shall be so optimised that the auxiliary system voltages under various grid and loading conditions are always within permissible limits and equipment are not subjected to unacceptable voltages during operation and starting of motors. The vector groups of the transformers shall be so selected that all the buses of particular voltage level have same vector through out the plant.
1.12.00	
1.13.00	All control and protection panels, 415V switchgears, MCC's, DC & AC distribution panels shall be painted by powder coating.
2.00.00	**ELECTRICAL SCHEME**
	The electrical schemes for the project as conceived by the Employer are shown on the electrical tender drawings (enclosed with the specification documents PART-E).
2.01.00	The scheme with minor variations to above may also be offered as long as they meet the redundancies indicated in the above drawings and sizing criterion specified.
3.00.00	**SIZING**
3.01.00	The overall system shall be such that failure of any piece of equipment has the minimum possible effect on the plant's capability. In particular, failure of unit and/or auxiliary transformer, DC battery, charger and DG set shall not reduce the plant's generating capability or affect the safe shut down requirements of the unit.
3.02.00	
3.02.01	
3.03.00	
3.03.01	

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3.07.00	**Cables** Cables shall be de-rated for the site ambient and ground temperatures, grouping, soil resistivity and cable laying configuration. Contractor shall furnish detailed cable selection / sizing criteria for Employer's approval. Cables shall be selected to limit maximum voltage drop at equipment terminals, during normal operation and starting conditions, well within permissible values. Voltage grade of cables shall be of earthed grade when used in solidly earthed systems and for resistive earthed system. It shall be unearthed grade when used in non-earthed systems. Fire proof cable penetration sealing system for 1 hour rating shall be provided.
3.08.00	**Motors**
3.08.01	Motors shall be rated for continuous duty (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor
3.08.02	Wherever the basis for motor ratings are not specified in the corresponding mechanical specification Sub-sections, maximum continuous motor ratings shall be at least 10% above design duty point or equal to the maximum load demand of the driven equipment under entire operating range including voltage and frequency variation.
3.08.03	In fire hazardous areas, totally flame proof motors confirming to IS shall be provided.
3.09.00	

5.04.00 Grounding and lightning protection for the entire power plant and other areas or buildings covered in the specification shall be provided in accordance with IS 3043,IS 2309, IEEE 80 and IEEE 665.

5.05.00 DC scheme shall provide at least two feeds through diode sharing to critical consumers e.g. all protection panels / control desks, 132 33KV/11KV circuit breakers, generator excitation system, generator oil seal system, etc. The details shall be subject to Employer's approval. For generator protection and protection panels for all 132 kV switchyard feeders, duplicated DC feeders shall be provided, one from each battery system.

5.06.00 Remote control facilities shall be provided for switchgears as per control requirements specified elsewhere in the specification.

6.00.00 FAULT LEVEL

Equipment through fault withstand capabilities under worst operating conditions duly taking into account negative tolerances on transformer, generator & maximum fault levels of source etc. shall be as follows :

iv)	Switchgears	- 1 second
v)	415V busducts / incomer cables	- 1 second
vi)	415V Cables to the outgoing feeders protected by breakers	Main protection fault clearing time with 0.12 seconds minimum
vii)	Cables of all other feeders	As per fuse operating time
ix)	132/33/11KV Cables & their screen	- 1 second
X)	Out door yard switchgear	- 1 second
xi)	Generator Transformers	- 3 seconds

7.00.00

8.00.03	Contractor shall furnish design calculations and construction drawings for all civil works showing details of pockets to be left in foundations and embedment to be provided in cable trenches.
8.00.04	Contractor shall furnish the schematics, general arrangement drawings, cable schedules, interconnection schedules, panel wiring diagrams, etc. for various control and relay panels for Employer's approval. Contractor shall also furnish the recommended relay settings to be adopted.
8.00.05	The Contractor shall note that the list of standards specified elsewhere in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specification, IS & IEC. In case governing standards for the equipment is different from IS or IEC, the salient points shall be clearly brought out along with English language version of the same.
8.00.06	Exposed live parts shall be placed high enough above ground to meet the requirements of Indian Electricity Rules and other statutory codes. All responsibilities regarding co-ordination with Electrical Inspection Agencies and obtaining clearance certificate from them rests with the Contractor.
8.00.07	All equipment shall be supplied with suitable terminal connectors. The terminal connector shall be well coordinated with the type/size of conductor and equipment to be connected. The conductor terminations for equipment shall be either rigid or expansion type suitable for tube or horizontal or vertical take off suitable for quad/dual/ single moose/Zebra The exact requirement to terminal clamps would be finalised by the Contractor in consultation with Employer based on layout requirement. The terminal pads shall preferably be capable of taking the required conductor span under normal, short circuit and meteorological conditions, without affecting the performance of the equipment.
8.00.08	All equipment shall be supplied with necessary inter-pole cabling, All the cables in the switchyard yard shall be armoured type.
8.00.09	The minimum temperature is expected to reach upto -5 C degree Celsius under extreme condition. The equipments shall be designed to withstand such conditions satisfactorily.
8.00.10	All outdoor equipment shall be suitable for hot line washing.
8.00.11	The Contractor shall cooperate in all respects and exchange the necessary technical data/ drawings with other agencies and Employer's other Contractors under intimation to Employer to ensure proper coordination and completion of work in time.
8.01.00	
8.01.01	

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8.01.02

8.01.03

8.02.00 **LT Switchgear**

8.02.01 AC Feeders:

The LT AC switchgear shall be designed to cater for all the loads required for bay marshalling kiosks, auxiliary power requirement. For reliability, each equipment and bay marshalling kiosk shall be connected with two independent sources of power supplies. The LT switchgear shall be suitable for power supplies to all Marshalling kiosks, maximum four (4) bay marshalling kiosks can be looped by forming a ring main. The LT switchgear panels shall be equipped with 20% spare feeders.

Two feeders of AC supply at 415V, 630A with ACB shall provided at SSB (inside the power house) for connection to the (two) nos of 415V, 3 phase AC distribution boards of 630A horizontal bus bar chamber and 16 nos of MCCB modules each with rating 63A for switchyard requirement.

8.02.02 **DC Feeders:**

The Contractor shall provide suitable DC distribution boards with busbars and all other equipments. For reliability, dual supplies for all loads shall be considered. 20% spare feeders shall be provided.

4 (four) feeders of DC supply shall be available in main & standby DC distribution boards of the power house for further connection to DC distribution boards for distribution.

8.03.00

9.00.00	**DEGREE OF PROTECTION**		
	Degree of protection for various enclosures as per IS: 13947 shall be as follows:		
9.01.00			
9.02.00	LT 415V switchgear/MCC/DBs/Fuse Boards		
	i)	Compartments and busbar chambers upto 1600A	- IP 52
	ii)	Compartments and busbar chambers above 1600A	- IP 42
9.03.00	Busduct enclosure		
	i)	Indoor portion including VT & SP cubicle	- IP 52
	ii)	Outdoor portion	- IP 55
9.04.00	Motors		
	i)	Indoor motors	- IP 54
	ii)	Outdoor motors	- IP 55
	iii)	CW motors (in case of screen prot. drip proof)	- IP 23
	iv)	Actuator	- IP 55
9.05.00	Control and relay panel		
	i)	In air-conditioned areas	- IP 31
	ii)	In other areas	- IP 52
9.06.00	Transformers		
	i)	Indoor Transformers	- IP 23
	ii)	Cable box - indoor area	- IP 54

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	iii)	Cable box - outdoor area	- IP 55
	iv)	Indoor kiosks and marshalling boxes	- IP 52
	v)	Outdoor kiosks and marshalling boxes	- IP 55
9.07.00	Push button stations / Marshalling kiosk / box / panel / cabinet / enclosure / industrial receptacle		
	i)	Indoor	- IP 55
	ii)	Outdoor	- IP 55
9.08.00	Junction boxes/Terminal boxes for cables/wires		- IP 55
9.09.00	Outdoor lighting fixtures/fixtures		- IP 55
9.10.00	Gen. Neutral grounding resistor		- IP 22
9.11.00	Battery charger		- IP 42

10.00.00 CONTROL PHILOSOPHY

SCADA system covered under "Control & Instrumentation" shall provide all control, including synchronisation, monitoring, indication, annunciation and metering for the entire electrical system covered under Bidder's scope. Refer Technical specification Part –B, Section-VI, Sub-Section – IIC, C& I for details.

The SCADA control location of entire electrical plant including out door yard switchgear shall be at the main plant CCR. To maintain uniformity, it shall be ensured that different components of SCADA namely OWS (operator's work station), LVS (large video screen) associated with power house control, out door yard switchgear control ,station auxiliaries control, DC system etc along with requisite furniture shall be similar in appearance and shade and shall be supplied by the same supplier.

11.00.00 TESTS

11.01.00 **Test Requirement for Service Transformers, LT Motors (above 50 KW), Air Insulated Switchyard Equipments (Isolators, 132 kV Circuit Breaker, Current Transformers, Capacitive Voltage Transformers, Surge Arrestors, Post Insulators, clamps, connectors, insulator strings, etc.), Protection Equipment, Battery, Battery Chargers (above 60 Amps), LT Power and Control Cables, DG Sets, Cable Joints and Termination Kits, Cable Tray Support System and Fire Proof Cable Penetration Sealing System, 33 KV, 11 KV & 415 V Switchgear.**

11.01.01 All equipment to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for the Employer's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the

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	equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
11.01.02	However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/owners representative and submit the reports for approval.
11.01.03	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
11.01.04	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of the Employer, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.
11.02.00	**Test Requirements for Generator and Auxiliary Systems .**
11.02.01	The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII-(Forms & Procedures) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the employer's engineer.
11.02.02	The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
11.02.03	In case the contractor has already conducted such specified type test(s), he may submit during detailed engineering the type test reports to the Employer for waival of conductance of such type test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
11.02.04	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

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11.02.05	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.
11.03.00	
11.03.01	
11.03.02	
11.03.03	
11.03.04	
11.03.05	

ANNEXURE-B

CLAUSE NO.	LT MOTORS (E14)
1.00.00	**GENERAL REQUIREMENTS**
1.01.00	For the purpose of design of equipment/systems, an ambient temperature of 40 deg.Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment.
1.02.00	All equipments shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.
1.03.00	Contractor shall provide fully compatible electrical system, equipments, accessories and services.
1.04.00	All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.
1.05.00	The auxiliary AC voltage supply arrangement shall be designed to limit voltage variation of +/- 10% under worst operating condition :
1.06.00	The voltage level for motors shall be as follows :- a) Upto 0.2KW : 240V, Single Phase AC/ 415V Three phase AC b) Above 0.2KW and upto 200KW : 415V, Three Phase AC
1.07.00	Fault level shall be limited to the parameters as indicated in Chapter Sub Section, E0.
1.08.00	Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor motors.
1.09.00	The responsibility of coordination with electrical agencies and obtaining all necessary clearances shall be of the contractor.
1.10.00	Degree of Protection Degree of protection for various enclosures as per IS:4691, IEC60034-05 shall be as follows :- i) Indoor motors - IP 54 ii) Outdoor motors - IP 55 iii) CW motors (in case of screen protected Drip proof) - IP 23

	iv) Cable box - indoor area - IP 54	
	v) Cable box - outdoor area - IP 55	
2.00.00	**CODES AND STANDARDS**	
	1) Three phase induction motors : IS:325, IEC:60034	
	2) Single phase AC motors : IS:996, IEC:60034	
	3) Crane duty motors : IS:3177, IEC:60034	
	4) DC motors/generators : IS:4722	
	5) Energy Efficient motors : IS 12615	
3.00.00	**TYPE**	
3.01.00	**AC Motors:**	
	(a) Squirrel cage induction motor suitable for direct-on-line starting.	
	(b) Continuous duty LT motors upto 160 KW Output rating (at 40 deg.C ambient temperature) ,shall be Energy Efficient motors ,Efficiency class- IE3 conforming to IS 12615.	
	(c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.	
3.02.00	DC Motors Shunt wound.	
4.00.00	**RATING**	
	(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.	
	(b) Whenever the basis for motor ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.	
5.00.00	**TEMPERATURE RISE**	
	Air cooled motors	
	70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.	
	Water cooled	
	80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation .	

6.00.00	**OPERATIONAL REQUIREMENTS**
6.01.00	**Starting Time**
6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
6.02.00	**Torque Requirements**
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.
6.03.00	**Starting voltage requirement shall be 85% of rated voltage.**
7.00.00	**DESIGN AND CONSTRUCTIONAL FEATURES**
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. Motors located in hazardous areas shall have flame proof enclosures conforming to IS:2148.
7.03.00	Winding and Insulation (a)Type : Non-hygroscopic, oil resistant, flame resistant (b)Starting duty : Two hot starts in succession, with motor initially at normal running temperature (c)415V AC & 220V DC motors: Thermal Class130(B) or better
7.04.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.

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7.05.00	Noise level for all the motors shall be limited to 85dB(A). Bearing housing vibration shall be limited within the limits prescribed in IEC 60034-14/IS:12075 . Motors shall withstand vibrations produced by driven equipment.
7.06.00	Motor body shall have two earthing points on opposite sides.
7.07.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.
7.08.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
7.09.00	The motors shall be suitable for bus transfer schemes provided on 415V system without any injurious effect on its life.
7.10.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) . (a) Upto 110KW: 11.0 (b) Above 110KW 10.0
8.00.00	**TEST**
8.01.00	**TESTS FOR LT MOTORS OF RATING 50 KW AND ABOVE:** Type test on each type and rating of LT motor of above 50 KW only. 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Locked rotor readings of voltage, current and power input at a suitable reduced voltage. 5. Full load test to determine efficiency power factor and slip . 6. Temperature rise test . 7. Momentary overload test . 8. Insulation resistance test . 9. High voltage test . 10. Test for vibration severity of motor. 11. Test for noise levels of motor .

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	12. Test for degree of protection and 13. Overspeed test.
8.02.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

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TABLE - I

DIMENSIONS OF TERMINAL BOXES

FOR LV MOTORS:

Motor MCR in KW	Minimum distance between centre of stud and gland plate in mm
UP to 3 KW	As per manufacturer's practice.
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	203

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	Clearance
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

Bidder's Name.....

TECHNICAL PARTICULARS

(This information is to be given by the Tenderer for each ratings and type of motor)

1.00.00	Manufacturer & country of origin	.....	.....
2.00.00	Equipment	.....	.....
3.00.00	(a) Motor type (Squirrel cage/ slipring/DC etc.)	.....	.....
	(b) Type of duty	.....	.....
4.00.00	Frame size & type designation	.....	.....
5.00.00	Applicable standard to which motor confirms	.....	.....
6.00.00	(a) Whether motor is flame proof	Yes/No	Yes/No
	(b) If yes, the gas group to which it conforms as per IS:2148	.....	.....
7.00.00	Standard rating at 40^0 C ambient temperature	.....	.....
8.00.00	Max. power input to the driven equipment at design duty point (KW)	.....	.....
9.00.00	Rated voltage & frequency	.....	.....
10.00.00	Stator winding insulation		
	(a) Class & type	.....	.....
	(b) Tropicalized	.....	.....
	(c) Temperature rise over specified ambient of 40^0C	.....	.....
11.00.00	Direction of rotation as viewed from non-driving end	.....	.....

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CLAUSE NO.	LT MOTORS (E-14)		
		Bidder's Name.....	
12.00.00	Full load current at rated voltage & frequency	.....	.....
13.00.00	Power factor at rated load	.....	.....
14.00.00	Starting current at		
	100% voltage	.....	.....
	Min. permissible starting voltage	.....	.....
15.00.00	Torques (kg-meter) at		
	(a) Starting	.....	.....
	(b) Pull-up	.....	.....
	(c) Pull-out	.....	.....
	(d) Rated torque	.....	.....
	(e) Accelerating torque at Min. permissible voltage	.....	.....
16.00.00	Number of permissible starts from hot condition	.....	.....
17.00.00	Paint Shade	.....	.....
18.00.00	Type of construction of rotor	.....	.....
19.00.00	Rotor insulation	.....	.....
20.00.00	Enclosure		
	(a) Type of enclosure and method of cooling	.....	.....
	(b) Degree of protection	.....	.....
21.00.00	Rated speed	.....	.....
22.00.00	Efficiency at design duty point (without -ve tolerance) & 100% full load	.....	.....
23.00.00	Power factor at design duty point	.....	.....

Bidder's Name.....

24.00.00	Type of mounting	.....	.....
25.00.00	Type of terminal box for stator leads	.....	.....
26.00.00	Bearing type		
	(i) Drive End	.....	.....
	(ii) Non Drive End	.....	.....

INDUCTION MOTOR & SYNCHRONOUS MACHINE (E-14)

TESTS/CHECKS / TEMS/COMPONENTS	Visual	Dimensional	Make/Type/Rating/TC/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y					Y
Shaft	Y	Y	Y	Y	Y	Y			Y
Magnetic Material	Y	Y	Y	Y	Y		Y		
Rotor Copper/Aluminium	Y	Y	Y	Y		Y	Y		Y
Stator copper	Y	Y	Y	Y			Y		Y
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y
Insulating Material	Y		Y	Y			Y		
Tubes for Cooler	Y	Y	Y	Y	Y				Y
Sleeve Bearing	Y	Y	Y	Y	Y				Y
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y	
Castings, stator frame, terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y	
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y				Y
Wound stator	Y	Y					Y	Y	
Wound Exciter	Y	Y					Y	Y	
Rotor complete	Y	Y					Y		
Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y		
Accessories, RTD, BTD, CT, Brushes, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.	Y	Y	Y						
Motor (IS 325 / 4722/ 9283)	Y	Y	Y						

INDUCTION MOTOR & SYNCHRONOUS MACHINE (E-14)

TESTS/CHECKS / ITEMS/COMPONENTS	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All tests as per IS-325/IS-4722 / 9283	Vibration	Over speed	Tan delta, shaft voltage & polarisation index test
Plates for stator frame, end shield, spider etc.									
Shaft									
Magnetic Material	Y		Y						
Rotor Copper/Aluminium									
Stator copper			Y						
SC Ring									
Insulating Material			Y						
Tubes for Cooler		Y							
Sleeve Bearing		Y							
Stator/Rotor, Exciter Coils									
Castings, stator frame, terminal box and bearing housing etc.									
Fabrication & machining of stator, rotor, terminal box									
Wound stator									
Wound Exciter									
Rotor complete				Y	Y				
Exciter, Stator, Rotor, Terminal Box assembly									
Accessories, RTD, BTD, CT, Brushes, Diodes, Space heater, antifriction bearing, cable glands, lugs, gaskets etc.									
Motor (IS 325 / 4722 / 9283)						Y	Y	Y	Y1

Note : 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality

2. Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalisation. However, no QP for LT motor upto 50KW.

3. Makes of all major bought out items will be subject to NTPC approval.

Y1 = for HT Motor / Machines only.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
	PROJECT:		PO NO.:	DATE:
	ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	M	C	N	
					M	C/ N								
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL
D: DOCUMENTATION

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
	Sign & Date	Name	Seal
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Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	TEST REPORT		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	MANUFACTURER'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	-	ASTM-A388	MANUFACTURER'S STD.	INSPECTION REPORT	✔	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	INSPECTION REPORT		P/V	-	-	
		2. PHYSICAL COND.	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	INSPECTION REPORT		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	INSPECTION REPORT		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	TEST REPORT		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
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Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180°	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	LOG BOOK		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	LOG BOOK		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	SAMPLE	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	LOG BOOK		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	

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					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✔	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.SHADE	MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.IR+HV-IR	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		4.RESISTANCE	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		5.INTERTURN INSULATION	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	THREE DIPS TO BE GIVEN

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Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
		3.HV	MA	ELECT. TEST	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	100%	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	TEST/INSPC. REPORT	✔	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	
		4.DIMENSIONS	MA	MEAS.	100%	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	

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					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	W*	-	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	ELECT.TEST	100%	-	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	ELECT.TEST	100%	-	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT	✔	P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	-	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	TC	✔	P	V$	-	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TC	✔	P	V$	-	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	-	IS-325/IS-12615& DATA SHEET	IS-325//IS-12615 & DATA SHEET	TEST/INSPC. REPORT	✔	P	V$	-	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	-	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✔	P	W$	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

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4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / (#)	INSPC. REPORT	✔	P	W	-	(#): REFER NOTE-8

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.

8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.

9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **B**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,

P: PERFORM, **W**: WITNESS, **V**: VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL

D: DOCUMENT

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