



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7
ON ASH DYKE AREA AT UKAI TPS**

**BID DOCUMENT
FOR
EPC CONTRACT**

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

**VOLUME - II
SECTION - 2
LEAD TECHNICAL SPECIFICATION**

STEAG Energy Services India Pvt. Ltd.
(A wholly owned subsidiary of STEAG Group, Germany)
A-29, Sector-16, NOIDA - 201301, India



INDEX

VOLUME	PART	SECTION	
I	A		COMMERCIAL
		1	NOTICE INVITING BIDS (NIB)
		2	INSTRUCTION TO BIDDERS
		3	GENERAL CONDITIONS (GC)
		4	SPECIAL CONDITIONS FOR ERECTION & CONSTRUCTION
	B		QUALIFICATION REQUIREMENT
	C		SCHEDULES
		SCHEDULE- 1	PRICE SCHEDULE – SUPPLY
		SCHEDULE- 2	PRICESCHEDULE–SERVICES
		SCHEDULE- 3	PRICE SCHEDULE - SPARES
		SCHEDULE- 4	PRICE SCHEDULE - TOOLS AND TACKLE
		SCHEDULE- 5	FORMATOFMONTHLYCASHFLOWCHART
		SCHEDULE- 6	SUPPLIMENTARY TECHNICAL SCHEDULE
		SCHEDULE- 7	DECLARATION SHEET
	D		GUARANTEE SCHEDULE
	E		BID FORMS
II			GENERAL
		1	PROJECT INFORMATION
		2	LEAD TECHNICAL SPECIFICATION
III			DETAILED TECHNICAL SPECIFICATION
	A		MECHANICAL
		1	STEAM GENERATOR & AUX. INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING SYSTEM
		2	STEAM TURBINE AND AUXILIARIES



		3	ASH HANDLING SYSTEM
		4	MATERIAL HANDLING SYSTEM
		5	PLANT WATER SYSTEM
		6	PIPING, VALAVES & SPECIALITIES AND THERMAL INSULATION
		7	FGD, LIME HANDLING SYSTEM & CHIMNEY
		8	COOLING WATER & AUXILIARY COOLING WATER SYSTEM
		9	COMPRESSED AIR SYSTEM
		10	AIR CONDITIONING AND VENTILATION SYSTEM
		11	FIRE PROTECTION AND DETECTION SYSTEM
		12	GAS CYLINDERS
		13	CRANES AND HOISTS
		14	NATURAL DRAFT COOLING TOWER
		15	ELEVATORS
		16	AUXILIAY BOILERS
	B		ELECTRICAL
		1	ELECTRICAL TECHNICAL SPECIFICATION
		2	TECHNICAL SPECIFICATION COMMUNICATION EQUIPMENT AND OPGW (24F & 48F DWSM)
	C		CONTROL & INSTRUMENTATION
	D		CIVIL, STRUCTURAL AND ARCHITECTURAL
IV			BID DRAWINGS
V			ANNEXURE



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

		1	PLOT PLAN
		2	DATA SHEET-B (TO BE FILLED BY BIDDER)
		3	MANDATORY SPARES LIST
		4	SUB-VENDOR LIST
		5	GEOTECHNICAL SURVEY REPORT
		6	TOPOGRAPHY SURVEY REPORT AND DRAWING
		7	ENVIRONMENTAL CLEARANCE
		8	PAINTING REQUIREMENTS
VI			AMENDMENTS



GUJARAT STATE ELECTRICITY CORPORATION LIMITED	VOLUME - II
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE AREA AT UKAI TPS	SECTION - 2
BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01	
LEAD TECHNICAL SPECIFICATION	REV. - A

VOLUME - II

SECTION - 2

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PREPARED BY



(An ISO 9001:2015 certified Company)

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TABLE OF CONTENTS

SUB SECTIONS	PAGE
1.00.00 INTENT OF SPECIFICATION	2
2.00.00 BROAD SCOPE OF SUPPLY AND SERVICES.....	3
3.00.00 BATTERY LIIMTS AND EXCLUSIONS	72
4.00.00 BASIC PLANT TECHNICAL AND DESIGN REQUIREMENTS	73
5.00.00 CODES AND STANDARDS.....	83
6.00.00 PLANT OPERATING CAPABILITY AND UNIT OPERATION PHILOSOPHY	86
7.00.00 QUALITY ASSURANCE AND CONTROL	95
8.00.00 PROJECT MANAGEMENT.....	99
9.00.00 SITE AND LAYOUT REQUIREMENTS	102
10.00.00 ERECTION, SITE TESTING, COMMISSIONING AND RELIABILITY TEST	117
11.00.00 PERFORMACE GUARANTEES AND ACCEPTANCE TESTS	142
12.00.00 SITE HEALTH AND SAFETY MANAGEMENT	192
13.00.00 SPARE PARTS.....	195
14.00.00 TOOLS AND TACKLES.....	197
15.00.00 CONSUMABLES	198
16.00.00 SURFACE PREPARATION AND PAINTING.....	199
17.00.00 APPROVED SUB-VENDOR / MAKES	201
18.00.00 PLANT AND EQUIPMENT IDENTIFICATION, LABELLING	201
19.00.00 DRAWINGS AND DOCUMENTS.....	202
20.00.00 ENVIRONMENTAL PROTECTION.....	214

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

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LEAD TECHNICAL SPECIFICATION

REV. - A

1.00.00 INTENT OF SPECIFICATION

- 1.01.00 GSECL (Owner) has decided to install 1x800 MW pulverised coal fired plant, based on state of the art Ultra supercritical technology at Ukai Thermal Power Station, in Gujarat state, India.
- 1.02.00 GSECL intends to install the plant through Engineering, Procurement and Construction (EPC) route by single turnkey contractor with single point responsibility basis.
- 1.03.00 This set of bid specification documents (hereinafter referred to as 'bid specification' or just 'specification'), including all its associated volumes, annexure, attachments, clarifications and amendments, is intended for the execution of the contract.
- 1.04.00 GSECL now intends to appoint a contractor for the design, engineering, manufacture/procurement, assembly, inspection and testing at manufacturer's works, packaging into properly sized units and shipping, transport, delivery to site, receipt, unloading, handling, storage, preservation, construction of civil and architectural works, structural fabrication, erection, painting, testing, commissioning, putting into operation; doing performance, reliability (trial operation) and guarantee testing and handing over of the completed plant, comprising all items as mentioned in the scope of works and services; including specified mandatory spares, tools and tackles, 3 year O&M spares and defect liability, for the proposed 1x800MW unit – 7 project of Ukai Thermal Power Station.
- 1.05.00 The EPC turnkey contractor (hereinafter referred to as "Bidder" in the bid specifications) would be responsible for all major aspects of installation; from basic engineering, detailed engineering, scheduling, procurement, project management, site management, construction, erection, supervision and quality control, performance testing and handing over of the plant as per the requirements of the bid specification. After award of the contract to the "Successful Bidder"; all references to "Bidder" in the bid specifications shall be read and interpreted as "Contractor" i.e. the EPC turnkey contractor who shall be completely responsible for execution of the comprehensive contract for the plant. Owner/Employer/Engineer/Client refers to GSECL.
- 1.06.00 The bidder will control the work of all his subcontractors and will be responsible for all their work.
- 1.07.00 This technical specification is intended to specify the minimum requirement for the plant. However the bidder can offer better configuration or technology to improve the plant performance or optimise the overall project cost (including capital or working/O&M cost). But any deviation has to be brought during the pre-bid stage and it has to be approved by the owner and owner's consultant by issue of relevant clarifications / amendment to the specification. No deviations will be allowed at a later stage.
- 1.08.00 This section also covers the general scope of supply and services, terminal points, general plant design and layout requirements, general quality and testing requirements, erection requirements, performance requirements, painting requirements, etc. Detailed technical requirements are indicated in other respective parts/sections of the specification.



1.09.00 The intent of the specification is to ensure that the plant & equipment under this package shall conform in all aspects, to high standards of engineering, design and workmanship and meet the intended performance of the plant, even if all details of design and construction are not specifically mentioned herein. It is the owner's intent that the specifications describe a functionally complete project/plant to be constructed in accordance with this specification. However, literal adherence to elements of this specification shall not relieve the bidder of ultimate responsibility for accomplishing the intent of the specification.

1.10.00 The intent of this specification is also to relieve the owner from any responsibility for completion of the plant in all aspects, as per the requirements specified herein, except the works to be performed by the owner, which is specifically mentioned as owner's responsibilities.

2.00.00 BROAD SCOPE OF SUPPLY AND SERVICES

2.01.00 The scope of supply and services covered under this bid specification include all activities within the specified battery limits/terminal/tie-in points for completion of the 1 x 800 MW thermal power plant as specified herein, right from site preparation to takeover of the entire plant by the owner; unless any item is specifically excluded from the scope of this specification. The plant shall be deemed complete, only when it has been taken over by the owner, without any further conditions; till then the complete plant is bidder's responsibility.

2.02.00 Although all efforts are made to make the scope as clear as possible, it may not be possible to specify each and every item herein. Bidder's scope & responsibility for this package shall comprise every equipment, material, items, structures and necessary auxiliaries and systems as a whole, including complete mechanical, electrical C&I and civil works.

2.03.00 The information in this specification is not intended to be a complete, exhaustive listing, but is provided for convenience of the bidder in developing an understanding of the overall scope.

2.04.00 Bidder's responsibility under this specification shall include everything which is required and necessary to complete the plant. The bidder's scope under this specification shall be deemed to include all such items which although may not be specifically mentioned in this specification, but are needed to make the system / plant complete in all aspects, in accordance with good engineering practice, for safe, reliable, efficient, trouble free operation and coordinated operation of the plant.

2.05.00 The bidder will provide all necessary fixtures, components, accessories, electrical and C&I accessories and appurtenances for efficient and reliable erection, operation and maintenance whether mentioned in this specification or not.

2.06.00 The extent of work under this contract includes all items shown in the appropriate sketches and drawings notwithstanding the fact that such items may have been omitted from the specifications or schedules. Similarly, the extent of work also includes all items mentioned in the specification and/or schedule, notwithstanding the fact that such items may have been omitted in the sketches and drawings.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 2.07.00 The bidder shall provide all the relevant inputs, drawings and data in proper format to other package bidders (if applicable), which is required for their detail engineering, to complete the project.
- 2.08.00 All necessary coordination and interfacing with sub-contractors shall be done by the bidder. The bidder will be responsible for all acts and omissions of any subcontractor and the owner will communicate only with the bidder regarding all matters pertaining to the contract.
- 2.09.00 All necessary coordination regarding interfacing with other package contractors (if applicable) shall be done by the bidder during detail engineering; with the approval of owner and owner's consultant.
- 2.10.00 Before preparation of the bids, the bidder may visit the project site and make himself familiar with the site/location conditions and understand all circumstances affecting the execution of the contract, including the extent and of work to be completed by him under this specification, means of transportation and access to site, facilities for accommodation of staff and labour (including those of sub-contractor's), storage and fabrication facilities available, availability of manpower, availability of construction material, labour and political issues, climatic conditions etc. Ignorance of site conditions shall not be accepted as basis for any claim for any type of compensation or extension of time.
- 2.11.00 The successful bidder upon signing of the Contract shall establish his office at the work site and in addition to a Project Co-ordinator/Manager stationed at his head quarters, nominate another responsible officer as his resident representative/Site in-charge, 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 to be established by the bidder and in close coordination with the Engineer.
- 2.12.00 All BOPs shall be completely commissioned in all respect before First Coal firing.
- 2.13.00 PG Test of whole plant (Boiler, Turbine, and Generator including all BOPs) shall be planned and completed before acceptance of COD.
- 2.14.00 All material handling system (Hoists, EOTs, etc) will be installed & commissioned before start of erection of respective area's equipments.
- 2.15.00 The scope of supply and services shall include but not be limited to the following:**
- 2.15.01 Basic & detailed design and engineering of the complete plant, including all systems, equipment and items.
- 2.15.02 Preparing and submitting engineering drawings and documents for owner's and owner's consultant's approval in agreed format and getting it approved after incorporating necessary changes. Submission of supporting drawings/documents/information sought by owner/owner's consultant, for this purpose.
- 2.15.03 Carrying out site investigation studies including, geo-technical investigation, topographic survey, area drainage study, water quality analysis etc for optimum design of the plant.

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VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 2.15.04 Procurement, fabrication, manufacturing, assembly, shop painting, marking, inspection and testing at manufacturer's works, packaging into properly sized units and forwarding, insurance, shipping/transport, customs/port clearance, delivery to site of each and every item required to complete the plant.
- 2.15.05 Receipt of all materials/equipment at site, unloading from carriers, handling for intermediate site storage, inspection at site for any shortage or damage and taking corrective action with the knowledge of owner / site in-charge, storage at site or other designated area near the site till the item is required for erection, security, protection and preservation at storage, handling from intermediate storage, transportation from storage area to location of erection.
- 2.15.06 Construction of civil and architectural works, structural fabrication, pre-assembly, erection, painting, pre-commissioning, testing, commissioning, putting into operation, performance, reliability (trial operation) and guarantee testing and handing over of the completed plant, comprising all items as per the requirements of this specification.
- 2.15.07 All associated site services as mentioned elsewhere in the specification and as required to complete the plant.
- 2.15.08 Arranging and channelling all resources required to complete the plant, as per the specification.
- 2.15.09 Deployment of additional resources as required to make-up for any delay in the project.
- 2.15.10 Installing latest and established pollutant monitoring system (flue gas/ effluent) at strategic locations of the plant to monitor and comply with pollution norms as specified by statutory authorities.
- 2.15.11 Maintaining the complete project area clean and organised.
- 2.15.12 Obtaining necessary clearances/permits/licenses from statutory authorities for the completion of the project, as mentioned in Volume-I.
- 2.15.13 Obtaining RTO approval for all the new vehicles supplied by the bidder.
- 2.15.14 Assisting owner and furnishing all relevant technical data for obtaining statutory clearances in owner's scope.
- 2.15.15 Preparation and submission of commissioning procedures and check lists for all equipment and systems.
- 2.15.16 All specialised equipment/services necessary for the package and all calibrated instruments and services required for performance testing of all items of the plant shall be made available for the purpose, by the bidder.
- 2.15.17 Provision for preservation of individual equipment after initial operation and commissioning, for example nitrogen blanketing etc. as necessary.
- 2.15.18 All structures which would be required by the bidder for supporting the piping and cables/cable racks. This includes complete pipe and cable racks/trenches/bridges.
- 2.15.19 All weld neck counter flanges, gaskets & fasteners shall be supplied by bidder wherever nozzle ends on any equipment such as strainer, flow nozzles etc. are flanged.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 2.15.20 All fixtures, embedded parts, steel embedment including fixing lugs and welding between them, foundation plates, nuts, bolts etc. for fixing all the equipments, piping on civil works.
- 2.15.21 Chemical cleaning of equipment and systems as required, after their erection.
- 2.15.22 Thermal insulation and removable metal cladding shall be provided, for all the equipment, piping and piping support frames, as required.
- 2.15.23 Complete platforms with handrails, for operation and maintenance of equipment and valves. Toe-guards should be provided for all handrails.
- 2.15.24 Complete piping (integral and interconnecting), fittings, couplings, expansion joints, valves, gates, gaskets, fasteners, instrument stubs and supports/hangers, as required for the plant.
- 2.15.25 All pumps, filters/strainers, storage/intermediate/day tanks, agitators, air receivers, specialities etc, as required.
- 2.15.26 Complete potable water and service water distribution to all buildings in the plant.
- 2.15.27 Individual overhead tanks at all locations for potable and service water as required.
- 2.15.28 Complete distribution of instrument air and service air piping for the plant.
- 2.15.29 All equipment complete with drive motors, coupling, coupling guard, base plates, anchor bolts, fasteners, gaskets, etc as required.
- 2.15.30 Complete electrical works for the plant including switchyard, transformers, bus-ducts, switchgears, cables, motors, local control panels, LPBS, illumination, battery, DC system etc.
- 2.15.31 Complete instrumentation required for both local and remote monitoring, process control and performance evaluation for all process parameters, including instruments, cables, control stations, PLCs, DCS etc.
- 2.15.32 Complete painting of all items of the plant. Cleaning, surface preparation and painting/corrosion protection including shop painting, before erection, during erection, after erection and application of final touch-up painting as required.
- 2.15.33 Complete consumables like grease, lubricating oils, chemicals, resins, filters, gases, etc. required for the plant till successful completion of PG test or COD whichever is later.
- 2.15.34 All the erection materials and consumables like shims, welding rods, soldering and brazing alloys, insulating tapes, compounds, chemicals etc. required for the erection and commissioning work shall be included in the Bidder's scope of work.
- 2.15.35 One set of all special tools and tackles of mechanical, electrical and C&I required for the maintenance of each equipment/system have to be supplied by the Bidder. These tools and tackles shall be separately packed and brought to site. These shall not be used for erection/ commissioning purposes and shall be in an unused and new condition, when they are handed over to the Employer. A list of all such special tools and tackles shall be submitted along with the offer.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 2.15.36 Adequate maintenance and repair tools required for inspection, testing, calibration and rectification during maintenance of equipments/system of the plant.
- 2.15.37 Complete set of spares as mentioned in the specification.
- 2.15.38 Carrying out flow model tests, as required, on models prepared by him and submitting the test reports for owner's and consultant's approval
- 2.15.39 Installation and removal of temporary items for commissioning, like piping, structures, equipment and other arrangements any, with the approval of Owner/Engineer; if such item is not required for normal operation and maintenance of the plant.
- 2.15.40 Completion and rectification/modification of all items as per punch list, before final takeover by owner.
- 2.15.41 Preparation and submission of all operation and maintenance manuals, including commissioning manuals for all equipment and systems for owner's approval and getting it approved after incorporating necessary changes.
- 2.15.42 Submission of final approved and as-built documents: 3 sets in Hard Copy as well as soft copy in 2 nos. Server Grade Computers (1 at site & 1 at corporate office) and 4 nos. SSD (2 at site & 2 at CO) for owner's record.
- 2.15.43 Training of owner's personnel at OEM/OES training centers in India and abroad as mentioned in relevant sections of the specification.
- 2.15.44 Defect liability of each part of the plant supplied, for a period of 12 months from the date of acceptance of system PG test or COD whichever is later; unless specified otherwise. Some of the specific requirements are mentioned in the specification.
- 2.15.45 Latent defect liability for the plant equipment under the specification after expiry of defect liability.
- 2.15.46 Technical/Service Experts from technological partner of bidder / design owner for erection, commissioning & PG Test activities of mechanical, Electrical and C&I systems shall be deputed till completion of such activities. Also, OEM/OES representative shall be deputed at site for erection, commissioning & PG test activities throughout till completion of such activities.
- 2.16.00 Plant & equipment to be supplied, erected & commissioned and civil scope are as under:**
- 2.16.01 STEAM GENERATOR, ITS AUXILIARIES, FGD, SCR, & MRHS
- i) One (01) number of once through, single/double pass (tower type/two pass type), single reheat, radiant furnace, dry bottom, balanced draft, outdoor type, pulverised coal fired, outdoor installation, steam generating unit having supercritical steam parameters with all necessary auxiliaries, integral piping, elevators, etc.
- ii) *Main plant and equipment shall include the following:*
- a) Complete steam generating unit with milling and draught plant for pulverised coal firing system, along with ignition and support firing system and low NOx burners, separated over fire air (SOFA) nozzles, all control,



protection and monitoring devices, Burner Management System, refractory and insulation as required.

- b) Provision of continuous purging line for flushing of Air flow DP transmitters
- c) Complete water cooled furnace wall, headers, risers, separators, drains, drain pipelines, valves etc. up to and inclusive of flash tanks and venting arrangement suitable for super critical parameters
- d) Steam generator structure, water circulation system, water-steam separator system (Evaporator or separator), start up re-circulation pumps with and superheating and reheating control system suitable for super critical parameters
- e) Pre-Boiler flushing arrangement (Line from HPH outlet to Condenser)
- f) Complete superheater system including headers, connecting pipes, vents, drain, pipelines up to flash tank, nitrogen connections, required number and type of safety valves and sampling connections
- g) Complete re-heater system including headers, connecting pipes, drains, drain pipes up to flash tank and required number and type of safety valves
- h) Two stage attemperation system for superheaters including control valves and upstream motor operated and downstream manual isolating valves with motor operated inching valve at bypass to control valve for superheater with control station.
- i) Emergency attemperation system for reheaters including control valves and motor operated up stream and downstream isolating valves with motor operated inching valve at bypass to control valve for re-heater with control station. All valves shall be MOV.
- j) Economiser system with connecting pipes, headers, etc.
- k) Two tri-sector or four bisector Regenerative Air Pre-heaters
- l) Coal Bunkers& Feeders along with sampling and measurement facilities
- m) Continuous exhaust gas emissions monitoring (CEMS) equipment at followings minimum locations:
 - 1) APH inlet and outlet
 - 2) ESP inlet and
 - 3) Stack.
- n) Boiler Fill system for SG
- o) Boiler preservation system with pumps including separate provision for dry layup of the boiler with N₂.
- iii) *Steam generator integral piping shall include the following:*
 - a) All drain piping from economiser headers, superheater headers, reheater headers, de-superheaters, etc. to drain collection headers with thermo-well provision to monitor high energy drains.

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AREA AT UKAI TPS**

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BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- b) Drain collection headers and drain connections to the flash tanks
- c) All drain piping from safety valves and drains of vent lines led to and terminated at trenches at the ground floor level
- d) All vent pipes and safety valves escape pipes to a level above SG house roof. The vents on the headers and tanks provided with drain lines connected to a common trough and further led to and terminated at the canal at the ground level
- e) All hangers and supports with auxiliary steel structure, including columns and beams wherever applicable; auxiliary steel for piping hangers and supports for piping in steam generator area, wherever applicable
- f) Attenuation line to superheater and reheater attenuation headers from feed water header (BFP discharge or outlet of last HP heater) or BFP inter stage tap off.
- g) Steam generator fill lines from boiler fill discharge line near steam generator area. Adequate steam generator draining facility from Bottom ring Header with higher volumetric capacity of drain sump and drain sump pumps to drain water removal facility.
- h) Piping, fittings and tapings as required; T-connections along with root valves in impulse pipes from where tapings are required to be taken for remote measurement in case provision does not exist for separate tapping points from the equipment for remote measurement and control
- i) Nitrogen capping pipe work including manifold with necessary valves for superheater
- j) Atomisation steam system for oil burners including pressure reduction unit with associated pipe work.
- k) Feed water piping from top HP heater outlet. (Feed water piping from downstream of feed check valve) With 4 x 50% bypass lines (2 line with SLVB & 2 lines with MOV).
- l) Auxiliary steam boiler along with auxiliary steam piping from auxiliary steam boiler to all the equipment requiring auxiliary steam during initial start of main boiler with capacity of at least 100 Ton per hour (TPH) steam generation.
- m) Pressure reduction and de-superheating station, if required for further reduction of the auxiliary steam pressure & temperature required for soot blowers and for SCAPH (required during steam generator start-up) along with necessary piping, valves and fittings from auxiliary steam header
- n) Pipe Tapping with valves before MSSV for Steam Blowing after annual shutdown.
- iv) *Following valves shall be included:*
 - a) Drain, vent and sampling lines provided with one valve or two valves in tandem depending on temperature, as specified in specification for valves.
 - b) Feed check valve and isolating valve with motor drive; the feed check valve location to be ahead of isolating valve in the direction of flow



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VOLUME - II

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AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- c) Superheater and re-heater safety valves-spring loaded
- d) Electromatic relief valves on superheater outlet
 - 1) 1 no. ERV on each right & left of Super Heater outlet
 - 2) 2 nos. ERV on each right & left of Re-Heater outlet
 - 3) ERV shall have isolating valve arrangement (MOV)
- e) Start-up drain and vent regulating valves with motor drives
- f) Start-up drain and vent isolating valves with motor drives
- g) All start-up vents, lowest set pressure spring loaded safety valves and electromatic relief valves at superheater outlet, lowest set pressure safety valves on re-heater outlet shall be provided with silencers; drains from the above safety escape pipes shall be terminated to a common trough and from trough to a common drain line to be taken to drain trench at the ground level
- h) All instrument tapping points with two root valves in tandem as specified
- i) AC motor driven main steam stop valve with separate bypass line with one isolating and one regulating valve
- j) Motor driven valves with necessary pressure transmitter provision for nitrogen capping system
- k) MOV or solenoid Valves for chemical feed connection
- v) Steam generator outer ribbed aluminium casing; aluminium sheet casing for equipment including hot air ducts, etc.
- vi) Complete air and gas duct work with necessary expansion joints, insulations wherever required, dampers and support steel work up to chimney with consideration of SCR and Wet FGD installation in the inline path of the unit.
- vii) Fly ash hoppers for steam generator second pass like economiser, Air preheaters, SCR and electrostatic precipitators.
- viii) Steam generator roof casing, including access doors; adequate number of access and inspection doors shall be provided for furnace, air pre-heater, economiser, fans, dust collection equipment and ducts.
- ix) Roof sealing arrangement to ensure dust free pent-house (pent-house ventilation system).
- x) Complete soot blower system including drain system and entire piping and fittings including control valves, piping and valves with necessary provision of measurement of drain temperature.
- xi) *Supporting and enclosing structure comprising:*
 - a) Steam generator supporting structure complete with girders, beams, guides, Buck stays, column base plates, foundation bolts, shims, etc.
 - b) Staircases of minimum 1200 mm width with handrails 100 cm high and 2 rail safety handrails of 40 mm galvanised iron (GI) pipe having florescent yellow colour / strip, on either side of steam generator and toe guards.



- c) Access platforms, staircases and walkways for soot blowers, man holes/inspection doors, dampers/damper drives, valves of critical services, ID fans, FD fans, PA fans, air pre-heater, transmitter racks, junction boxes, etc. Staircase/interconnecting platform shall be provided to access mill platform from both mill foundation and Boiler.
 - d) Approach platforms shall also be provided to bunker outlet gate, Mill discharge valves, all dampers and drives, furnace seal trough, fans and motors, Air pre heaters, all valves, all electrical and pneumatic actuators, field control and instrumentation points, etc. as per best engineering practices.
 - e) Toe boards for all staircases, platforms and walkways
 - f) Firing aisle platforms with enclosure with GI sheet covering
 - g) Steam generator roof and penthouse including GI sheet roof for penthouse, penthouse cooling fans /ventilation system. The steam generator roof shall be provided with an approach ladder and all round hand railing. Roof cladding shall ensure no water ingress on the penthouse roof or other boiler area.
 - h) Interconnecting platforms between the steam generator and station building/power house building, between the steam generator and switchgear building, SG and Mill Bunker structure at operating floor level and SG Back pass and ESP Top interconnection
 - i) All walkways and platforms unless specifically indicated shall be minimum 1200 mm wide
 - j) GI sheet cladding of equipment wherever necessary for operation and maintenance
 - k) Structures for support of monorails of ID fans, FD/SA fans, PA fans, air preheaters, coal mills and ESP maintenance.
- xii) *Air and flue gas system as below:*
- a) Two (02) nos. (2x60% BMCR) axial, blade pitch controlled primary air (PA) and two (02) nos. axial blade pitch controlled forced draught fans each with motor complete with coupling and coupling guard, silencer, lubrication system (2x100% pumps, coolers, filters etc.), systems for stalling protection, flow measurement of individual fans and base plate, foundation bolts, inlet box, rain water canopy, bird/trash screen, required actuators, adequate instrumentation, bearing temperature sensors etc.
 - b) Two (02) nos.(2x60% BMCR) axial type blade pitch controlled ID fans each with motor, diffuser, coupling and coupling guard, lubrication system (2x100% pumps, coolers, filters etc.) , systems for stalling protection, flow measurement of individual fans and base plate, along with foundation bolts, required actuators, adequate instrumentation, bearing temperature sensors etc.
 - c) Two (02) tri-sector (2x60% BMCR) or four (4) bisector regenerative air pre-heaters with auto seal arrangement (preferable).

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- d) The air pre-heaters shall be provided with necessary shaft drives and a standby air motor drive(with air receiver tank, piping valves and instruments etc.), the hand operation facility shall be replaced by an extra electric motor operation (in total two motor drives and kone air drive systems) , off load washing facility with required supply piping & valves, drainage etc. (tapped from service water system), permanent fire fighting system and fire sensing equipment, at both cold & hot ends and in both air and flue gas sides along with necessary piping , valves etc. (connected to fire fighting system), Ash collection hoppers with disposal flanges along with RF type level switches, bearing lube oil system. High Ash level indicators shall also be provided for Economizer, APH & Duct Hoppers.
- e) Two (02) Steam coil air pre-heaters in the bypass duct to discharge duct of FD fans with associated steam supply stations with necessary instrument & control arrangement and drain collection systems. If bi sector air pre heaters are supplied, then steam coil air pre heaters shall be provided in both PA fan and FD fan discharge bypass circuits.
- f) Forced oil lubrication system for the fans and motors shall consist of 2 x 100% oil pumps each with motors, coupling and coupling guard, 2 x 100% oil coolers, 2 x 100% oil filters as per manufacturer's standard, one (1) oil tank with accessories.
- g) Cold air, hot air and flue gas ducting.
- h) Sealing air duct to coal mills, feeders, etc.
- i) Turning vanes/baffle plates, duct stiffening devices, interior bracings, slide plates, expansion joints, mating flanges, access doors and brackets, supports structure and hangers as applicable.
- xiii) *Warm-up / Start-up/Support Oil Burning System*
- LDO system shall be as per the Bid drawing but not limited to the following:
- a) One (01) no. additional 500KL LDO tank shall be installed in the existing Fuel Storage area. This tank shall be connected with filling connection from the existing unloading system and existing storage tank.
- b) Two (2x100%) LDO transfer pumps, to transfer LDO from existing LDO storage tank as well as new LDO tank to the LDO Day tank of this 1 x 800 MW Unit.
- c) One (01) no. LDO Day tank (in new plant area)
- d) Three (3x50%) LDO pressurising pumps each with motor coupling and coupling guard, simplex suction strainer at pump inlet, base plates, drain rim / pans, burners, trip valves, nozzle valves etc..
- e) All piping, valves and fittings, insulation as required from existing fuel tanks (LDO tanks) to fuel burners, return lines to tanks, drains, atomising lines etc.
- f) Instrumentation and control as required (Local as well as Remote C&I)
- xiv) Coal preparation and burning equipment



- a) Generally, vertical spindle medium speed Coal mills confirming to sizing criteria/ standby requirement, each with drive motor, coupling and coupling guards, dynamic classifier, wear parts, grinding elements, gear, adequate instrumentation for safe and optimum operation, shall be provided.
- b) Mill lubrication system with 2x100% capacity oil coolers, 2x100% capacity pumps, pipes etc, for each mill.
- c) Base plates and foundation bolts.
- d) Gravimetric belt coal feeders each with variable speed, motor, coupling and coupling guard, base plate, foundation bolts, sliding joints, paddle switches for sensing presence or absence of coal, coal motion monitors, micro processor based precision weighing & calibration system, strain gauges, with all the required instrumentation, complete in all respects.
- e) Coal burners (Low NOx) with erosion proof coating
- f) Seal air fans each with motor, coupling and coupling guards and mechanical filters on suction with necessary instrumentation with remote damper operation.
- g) Adequate numbers of coal bunker having 16 hrs storage capacities at 100% BMCR operation, taking 20% filling factor considering design coal as fuel.
- h) Stainless steel raw coal piping from bunker outlet to feeders and from feeders to mills inclusive of sliding isolation gate valve for shutting of bunker and a isolating gate valve at coal feeder inlet facility to operate remote as well as local operation (facility to operated it with a chain from feeder floor), remote operated shut off gate valve between coal feeder and mill, required couplings (with 410 SS liners) etc.
- i) Pulverised coal piping from mills to burners with two stage isolation and temperature measurement of CAT in individual pipes and provision of Bio-mass co-firing compatibility of Milling system, instrumentations, logic/auto control loops.
- j) Complete seal air piping and hot air piping
- k) Flanged filler piece one each between bunker outlet and feeder inlet and one carbon steel diverter chute connection piece with flanged outlet for emergency dumping of coal from the bunkers
- l) Proven Coal mill inerting system / fire fighting system with the required detection and alarm system, piping, valves, required instrumentation
- m) All isolating, regulating valves as required and required couplings and coupling guards
- n) Pyrite hopper with each mill for collecting waste coal / other material
- o) Handling facilities for heavy mill parts.
- p) Gravimetric belt feeder



xv) Ducting

- a) Cold air ducting to FD fans suction, FD fans discharge to air pre-heaters, bypass ducts for locating SCAPH with individual pressure and temperature measurement.
- b) Cold air ducting to PA fans suction, PA fans discharge to air pre-heaters, bypass ducts for locating SCAPH
- c) Hot air ducting from APHs to burner boxes and coal mills
- d) Flue gas ducting from economiser to APHs and from APHs to ESPs, Flue gas ducting from ESPs to ID fans and from ID fans to FGD and bypass to chimney/ wet stack
- e) FGD Inlet and outlet flue gas Ducting & outlet ducting to wet stack.
- f) SCR inlet and outlet ducting (2x60% streams) including isolation dampers and hoppers, as applicable for the system.
- g) Chimney inlet transition pieces, counter flanges, flow splitters, expansion joints, brackets, hangers, ash hoppers(if applicable), Turning vanes, baffle plates, stiffening devices, interior bracings, expansion joints, access doors supports and hangers, support structure etc.
- h) Ash collection hoppers below economiser and APHs as required.
- i) Any other ducting required to complete the system of air and flue gas path.
- j) Continues purging system shall be provided for SA flow transmitter.

xvi) Ignition system

- a) HEA igniter for each fuel oil (LDO) burner, spark rod, retract mechanism, exciter system including step up transformers, rectifier, storage capacitor and a trigger gap along with necessary special cables
- b) Scanner and Scanner Air System
- c) Adequate number flame scanners, necessary piping and valves
- d) 2x100% scanner air fans (one AC and one DC motor operated)

xvii) Soot blowing system

- a) Short retractable rotary wall blowers in furnace, Long retractable and rotary blowers in superheater, re-heater and economiser. Future space provision shall be given in arch zone in-case of ash accumulation.
- b) Motor drive for each blower with coupling and coupling guard, base plate, frame and holding bolts
- c) Speed reducers, cam chain drive and other auxiliaries
- d) Emergency hand cranks for all soot blowers
- e) Supporting structure
- f) Complete piping system with vent, drains, relief valve, etc. as required
- g) Instrumentation and control as required, control based on Heat flux on the water walls – micro processor based



- xviii) Two (2) nos. approved type furnace inspection and maintenance equipment covering all four furnace walls.(Similar to sky climber)
- xix) Dampers
- a) Isolation dampers with electric drives on all cold air, hot air, seal air, and flue gas ducting before and after equipment on these systems with sealing as per requirement.
 - b) Electrically operated guillotine type gas tight isolators at inlet and outlet of ESP, inlet and outlet of each ID fan, inlet and outlet of each RAPH for local/remote operation; along with 2x100% sealing fans arrangement for each damper. However, inlet and outlet of FGD & FGD bypass ducting shall be provided with multi-louver damper along with 2x100% sealing fans. FGD bypass shall be provided with two multi-louver dampers (at branch-out and at branch-in location).
 - c) Air registers with drives at various elevations.
 - d) Regulating dampers with pneumatic drives, as required; supporting structure for all damper drives
- xx) Selective Catalytic Reduction (SCR) De-NO_x system complete with all accessories and auxiliary equipment -
- a) Complete DeNO_x system (2x60% SCR module) shall be provided for Steam Generator. The scope of SCR system shall include but not limited to the following to meet the NO_x level as specified in the specification.
 - 1) De-nitrification equipment
 - SCR catalyst complete modular package.
 - SCR reactor, including housing, and mixing devices (as required), module support structure, soot blowers and ash hoppers (if applicable).
 - Complete transition ductwork from steam generator economizer outlet flange to the reactor inlet and from reactor outlet to air heater inlet flange(s), including expansion joints, flow straightening devices, and supports. Bidder to provide 2x60% double stream configuration. Each stream shall cater the requirement corresponding to 60% BMCR operation. Bidder may consider partial economizer bypass duct & bypass damper from economizer inlet to SCR reactor inlet to ensure the minimum tolerable gas temperature at SCR inlet at low load (35% TMCR/ 280MW) operation.
 - SCR duct hoppers.
 - Ammonia Injection grid including support.
 - Ammonia vaporization system complete with 2 x100 % (1W +1S) dilution air blower with motor, inlet filters, mixing chamber along with complete piping, valves & supports.
 - Alternatively Bidder may offer dilution air connection from FD fan outlet header as per their standard and proven practice.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 2) SCR system, Unloading, Handling and other Miscellaneous Works
- Catalyst handling equipment, including monorail for loading and unloading of catalyst module from grade.
 - SCR reagent storage tank(s) complete with support saddle, access ladder, platforms, level indicators, safety valves, high and low level alarms, excess flow valves, and other accessories as required. Ammonia sensing devices & alarming devices in the tank area shall be provided.
 - One truck unloading rack with hose connections for receiving SCR reagent from the truck and for vapor return to the truck including hoses and isolation valves for lines connecting the rack to the storage tank shall be provided.
 - One SCR anhydrous ammonia vaporizer per storage tank complete with supports, electric heater, local controls, safety valves, and other accessories as required shall be provided.
 - One truck unloading system, containing two full-capacity compressors/pumps(1W + 1S) complete with motors, suction and discharge piping, supports, valves, local controls, and accessories required for control, maintenance, and safe operation of the compressor and vapour recovery system.
 - Interconnecting piping from unloading station to storage tanks and from storage tanks to ammonia injection grid shall be provided.
 - Heat tracing equipment's and accessories (if required) for process temperature maintenance or freeze protection shall be provided.
 - Shop priming of exposed steel surfaces.
 - Protective lining and coatings as required for the system.
 - Ammonia leak detectors.
 - All control and instrumentation items with applicable Hazardous area classification shall be provided.
 - Associated Electrical & civil works.
 - Water spraying system in NH₃ area as a safety measure.
- 3) Control and Instrumentation
- Process control equipment's along with complete instruments and interfacing to Unit DCS shall be provided as specified in relevant C&I portion of the specification. One set of additional hot redundant controller with I/O cards and complete hardware & Software etc. shall be provided with Unit DCS for control, operation & monitoring of SCR system.
 - NOx analyzer and oxygen trim at the reactor outlet, NOx analyzer at the reactor inlet with oxygen trim (if necessary), sample probes, dryers, sample conditioning units, sample pumps, solenoid valves,



and other accessories as required, mounted in a cabinet, with heating, ventilation, and air conditioning (if necessary).

- Bidder shall also follow the complete requirements for control and instrumentation volume.

xxi) Electrostatic precipitator

- ESP, complete in all respects with all components and accessories etc;
- ESP with six independent streams/passes housed in independent casing, with minimum seven (7) electrical fields having one (1) field standby, including outer shell; complete with structural steel supports, framework, interior access walkways, exterior platforms, staircases and handrails of 40 mm GI pipe having florescent yellow color or yellow strips, access doors, weather proof pent house etc.
- Inlet & outlet flues, transitions and expansion joints, matching flanges
- Gas distribution system complete with turning vanes/deflector plates, flow splitter, guide vanes, perforated plates and all necessary gas flow control devices in the inlet and outlet cones and duct, warranted by the results of the model tests.
- Complete duct stiffening devices, interior bracings, slide plates, hangers, sample connections etc.
- Reinforced sheet steel casing
- Fly ash collection hoppers complete with thermal insulation, heaters, level indicators & transmitters, outlet flange, jointing materials, poke holes, access door and walkway/platform beneath hoppers. ESP Hopper bottom flange height shall be 3.5 mtrs from FFL.
- Inspection and maintenance access doors with frames and safety locks.
- Safety devices and safety barriers, etc.
- Collecting and rapping systems complete with supporting insulators, collecting and discharge electrodes, structural supporting frames, automatic rapping controls, shaft insulators, bush insulators etc.
- High voltage transformers, rectifiers, bus sections with sectionalising and grounding switches and controls. HV TR Set shall be provided with FRP canopy.
- Automatic voltage control system
- Weather proof enclosure for insulator compartment complete with heaters, air blowers, filters, controls, etc.
- AC electric drive motors as required
- Electrical and instrumentation and control equipment as required
- Monorails and Electric hoists on the roof, for handling transformer rectifiers.
- Water washing system for the ESP and its hoppers along with all tanks, pumps, piping, valves and nozzles etc.



- r) Thermal insulation, lagging, cladding and refractory, as required. Thermal Insulation along with aluminium cladding, lagging, reinforcement wire-mesh, cleats and supports, shall be provided for all the equipment/surfaces having skin temperature more than 60 degree Celsius.
- s) Opacity monitors/meter, complete with all accessories at the outlet of each pass/stream.
- t) Energy management system
- u) Provision for fluidising pad /air inlet arrangement for ESP hoppers.
- v) Suitable connections shall be provided for:
 - 1) Draft gauge measuring points on each inlet and outlet of precipitator section
 - 2) Temperature measuring points on each inlet and outlet of precipitator section.
 - 3) Adequate numbers of test connections of standard size and at suitable location to permit velocity, dust loading and temperature distribution measurements at the inlet and outlet of the precipitator
- w) For assessment and design of appropriate flue gas flow distribution in the ESP(s) and the duct work connected on the upstream and downstream sides of the ESPs, the Contractor shall conduct comprehensive model testing by developing physical Scale model by fabricating a three dimensional physical model of the Electrostatic Precipitator and it's ducting with a scale not less than 1:10.
- x) Process control equipment's along with complete instruments and interfacing to Central Unit DCS shall be provided as specified in relevant C&I portion of the specification. One set of additional hot redundant controller with I/O cards and complete hardware & Software etc. shall be provided with Central Unit DCS for control, operation & monitoring of ESP.
- xxii) All the miscellaneous cranes and hoists required for the equipment coming in BTG island.
- xxiii) Elevators for buildings/structures which has operation/maintenance floor (where man / machine movement access is required for regular O&M of the plant), above 10m from FFL, for each structure like boiler, ESP control building, FGD area structure/buildings and chimney for accessibility to various levels, along with the mandatory staircase / cage ladder.
- xxiv) Mill Reject Handling System
 - a) Complete Mill Reject handling system (Pyrites handling system) including Pyrite Hopper, pyrite cooling arrangements, bucket elevators, conveyors for transportation to the storage silos and arrangement for loading the rejects to the trucks from silos, all chute work, all pipe works along with valves and fittings.

**2.16.02 STEAM TURBINE AND AUXILIARIES**

- i) The scope includes all equipment required for One (01) no. Steam Turbine Generator unit along with auxiliaries of the type specified. Steam turbine and its auxiliaries shall include but not be limited to the following:

a) Steam Turbine

- 1) The steam turbine shall be of tandem compound construction, condensing type with minimum eight (08) numbers of extractions with extraction for the top HP heater from the HP turbine for regenerative feed heating. HP turbine shall be of double casing design. Separate HP, separate IP and separate LP casing(s) or combined HP-IP and separate LP casing(s) shall be provided. HP inner cylinder, IP cylinder and LP cylinder(s) shall be horizontally split.
- 2) Steam turbine shall be complete with casings, rotors, bearings, temperature detectors, couplings, steam gland seals, rotor turning gear preferably hydraulic type and having local/remote operation facility, hand barring gear, emergency stop and control valves and reheat stop and control valves with their servomotors, removable type steam strainers for start up and normal operation upstream of emergency stop and reheat stop valves, cross-over/cross around piping and electric motors for all its integral subsystems. Steam strainers integral with main steam emergency stop and reheat stop valves are also acceptable.
- 3) Hydraulic/pneumatic power operated quick closing non-return valves and ordinary non-return valves for each extraction line (except for heater(s) located in condenser neck) including steam lines to BFP turbine drives and for each cold reheat line one hydraulic/pneumatic power operated quick closing non-return valve(QCNRV) shall be provided. The type of actuation i.e. hydraulic/pneumatic shall be as per the standard proven practice of the manufacturer.
- 4) Turbo generator set will be suitable for installation on Rigid deck design foundation.

b) Steam Turbine Auxiliary systems

- 1) Turbine gland sealing steam system shall be provided with gland steam condenser, gland steam exhausters, all associated motors, associated piping, valves and fittings, specialties, hangers and supports, necessary insulation and complete with all instrumentation and control hardware including electro hydraulic/ electro pneumatic controller, actuator, electro hydraulic / electro pneumatic converter etc. as to make the system complete in all respects.
- 2) Cross over/ cross around piping between IP and LP casing(s) including necessary hangers and supports for piping and secondary structural steel shall be provided, if required.
- 3) Lubricating Oil System shall be complete with oil tanks, oil purifying system, oil pumps and jacking oil pumps with drive motors, oil coolers, strainers, vapour extractors with drive motors, all



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

interconnecting piping, valves and fittings, hangers and supports, necessary instrumentation and control hardware to make the system complete in all respects. Lube oil system shall also be supplied with trolley mounted independent oil filtration system to maintain NAS value during normal O&M.

- 4) Oil storage and purification system including clean oil tank, dirty oil tank, transfer pumps, purifying unit with interconnecting piping, necessary instrumentation and control hardware to make the system complete in all respects
- 5) Steam turbine control fluid and its purification system along with its conditioning system shall be complete with control fluid tank, control fluid pumps with drive motors, strainers, accumulator, control fluid coolers, waste fluid tank, purification equipment including fluid circulation pumps with drive motors, associated piping, valves, fittings and specialties, hangers and supports, Instrumentation and control hardware to make the system complete in all respects for the 800 MW unit.
- 6) Steam turbine governing and protection system shall be complete with high pressure electro hydraulic governor with mechanical hydraulic back-up or electro hydraulic system with 100% hot back-up, electro hydraulic converter, hydraulic converter, tracking devices, hydraulic speed governor, electrical speed sensors, speed/load adjusting gear, motor drives, remote trip solenoids, over speed, low condenser vacuum, low lube oil pressure, high axial shift and other trip/protection devices, electrical components associated with electro hydraulic system, test devices and test panel inserts etc. and hydraulic components like accumulator, strainers etc. along with associated piping, valves, fittings and specialties, hangers and supports.
- 7) Steam turbine exhaust hood spray cooling system shall be complete with spray arrangements, associated piping, instrumentation and control devices, valves and fittings, motor/solenoid operated valves and specialties, hangers, supports and insulation etc.
- 8) Steam turbine, associated piping & equipment drain & vent system shall be complete with turbine flash tanks, piping, valves and fittings, valve motor drives, specialties, hangers and supports, insulation, instrumentation and control etc. Vents shall be led to atmosphere up to a suitable location outside the main plant building.
- 9) Unit flash tank vent shall be located such that it remains at highest point of the TG building such a way that exhaust steam from vent shall not come in contact with any mechanical or electrical structure or equipment.
- 10) Turbine preservation system consisting of adequate numbers of air driers including, fans, motors, filters, heater drying wheel, connecting piping, valves, fittings etc. for preservation against corrosion of turbine during idle periods shall be provided.



- 11) Boroscopic inspection ports in turbine for in situ inspection of turbine internals shall be provided as per bidder's standard practice.
 - 12) Steam turbine aesthetic and acoustic enclosure (removable type) with necessary ventilation and lighting system
 - 13) HP/LP Bypass system shall be complete with steam and spray water line valves, spray control station, throttling devices, fittings, desuperheaters, hydraulic power pack, solenoid valves, quick acting devices, blanking devices for steam blowing, supports, associated piping including warm up arrangements, valves, instrumentation and control hardware, electrical devices and actuators/motors etc. Proportionate valves shall be used in control valves for longer reliability to avoid passing issue.
 - 14) Water cooled, divided water box, horizontal surface condensers completed with all accessories such as hotwells, valves, drains, vents, strainers, CW line expansion joints and fittings, isolating butterfly valves with matching flanges, associated CW piping to and from the condenser, suitable handling arrangement(s) for water box & butterfly valves, steam throw off devices for HP-LP bypass system, extraction steam piping routed through the condenser to low pressure feed water heaters and heater(s) within the condenser neck and with provision for installation of low pressure feed water heater(s) in the condenser neck, shall be provided.
 - 15) HP and LP flash tanks / vessels for accepting all turbine and cycle recoverable drains including those from main steam, cold reheat, hot reheat lines, HP-LP bypass lines, heater drains, complete with all associated spray system, piping, valves and fittings, specialties, hangers and supports and insulation, instrumentation and controls etc. shall be provided. In addition one atmospheric flash tank will also be provided to accept the drains from feed water heater safety valves.. All flash tanks shall be provided with 2x100% spray control valve with redundant temperature indicator and transmitters.
 - 16) Condenser air evacuation system shall be complete with 2 X 100% vacuum pumps for each condenser, associated motors, all accessories, associated piping, valves & fittings, specialties, duplex filter, instrumentation and control etc. adequate margins in Heat exchangers of vacuum pump shall be envisaged and cooling water flow shall be controlled by inching type MOV or Control Valve.
- c) TG Integral and other miscellaneous piping
- 1) The scope of work for TG integral and miscellaneous piping covered under this specification shall include but not be limited to the following systems:
 - Condenser air evacuation system
 - Condenser cooling water system
 - Cycle make-up system



- Control fluid system
- Gland steam sealing system
- Lube Oil system
- Seal oil system, stator water cooling, H₂/CO₂/N₂ generator gas cooling system, any other piping, valves and specialties to make the system complete. Preferably Single flow ring relief Seal oil system shall be used
- Central oil storage and purification system
- Exhaust hood spray system
- Gland sealing (of valves and pumps) system
- Equipment cooling water system
- Compressed air system (Service Air and Instrument Air)
- Piping shall be complete with fittings / accessories and specialties, expansion joints, valves, insulation, hangers, supports, restraints / guides, snubbers and auxiliary steel etc. The design and engineering of the piping system shall include but not be limited to pipe sizing, hanger / snubber engineering, engineering of thermal insulation etc.

d) Condenser on-load tube cleaning system (COLTS)

- 1) Sponge rubber ball type condenser on load tube cleaning system separately for each half of the condenser. Condenser on load tube cleaning system shall be complete with Ball recirculation pump, Ball separator, Ball collecting vessel, differential pressure measuring system, Ball monitoring system (comprising of ball recirculation monitor and ball oversize monitor), associated piping, valves and accessories, instrumentation and controls, all drives, power and control cables, motors and accessories, etc.

e) Condensate extraction pumps

- 1) 3 x 50% capacity motor driven condensate extraction pumps along with all accessories, drives, suction strainers, associated piping, and valves, instrumentation and control etc. including one number cannister drainage pump per station shall be provided. CEPs shall be provided with Motor operated Suction and Discharge Valves.

f) Feed water heating plant

- 1) Complete regenerative feed heating system including full capacity drain cooler, minimum Four (04) nos. of low pressure heaters, deaerator and feed storage tank, minimum three (03) nos. of high pressure heaters, all accessories, associated piping, valves, Nitrogen gas and filling arrangement, instrumentation and controls etc. shall be provided. One set of test kit for measuring oxygen content at deaerator outlet shall also be provided



g) Boiler Feed Pumps

- 1) One half capacity (1x50%) motor driven boiler feed pump (MDBFP) completed with booster pump along with it's drives, mechanical seals, flexible couplings, hydraulic coupling, gear box, base plate(s), forced oil lubricating system (including oil pumps, oil tank, lube oil coolers, working oil coolers, duplex oil filters etc.), Automatic recirculation flow control valve, integral piping and valves, temporary and permanent strainers, local instrument racks/enclosures, instrumentation and control etc. shall be provided. One (1) number portable centrifuge of adequate capacity shall also be provided.
- 2) Two half capacity (2x50%) steam turbine driven boiler feed pumps (TDBFP) completed with booster pump, step down gear box, flexible couplings, mechanical seals, foundation base plates, Automatic low load recirculation flow control valve, integral piping and valves, local gauge boards, instrumentation and control etc. shall be provided. Total capacity of two pumps (2 TDBFP or 1 TDBFP and 1 MDBFP) shall be VWO condition feed water flow at 1% make-up plus 10% margin.
- 3) Two (2) steam turbine drives for the turbine driven boiler feed pump completed with ESV, control valves, non return valves for single admission drives, permanent & temporary steam strainers, preferably hydraulic turning gear, hand barring device, atmospheric relief diaphragm and it's vent piping, all inter connecting piping, foundation base plates, integral gland seal system, complete lube oil and control oil system including oil tank, oil coolers, duplex oil filters, vapour exhausters, 100% capacity centrifuge for each steam turbine driven pump, jacking oil system,
- 4) Electro-hydraulic governing system, Turbine Supervisory system along with all control and accessories as specified elsewhere in the specification shall be provided.
- 5) Boiler feed pump sets shall be suitable for installation on spring supported Reinforced Cement Concrete (RCC) foundation.
- 6) Feed regulating station (FRS) for feed water flow control.

h) Make-up System

- 1) Normal and emergency cycle make-up to condenser hot well consisting of piping, valves, flow elements with flow transmitter and indicators, hot well makeup control station (normal and emergency) including control valves, drain, vents, condensate spill pipe line consisting of piping, valves, control station, condensate storage tank and emergency make up pumps.

i) High pressure/power cycle piping shall include

- 1) High pressure piping covering complete main steam, hot reheat and cold reheat piping between boiler and turbine nozzles, HP - LP bypass piping;



- 2) Complete auxiliary PRDS and auxiliary steam piping system;
 - 3) All extraction steam piping;
 - 4) Complete feed water piping including booster pumps suction, inter connection between booster pumps and main pumps, boiler feed discharge piping up to economiser, recirculation, BFP warm up and leak off and BFP turbine exhaust piping to condenser, Feed water line for pre-boiler flushing i.e. HPH O/L (Before Economizer) to Condenser;
 - 5) Spray piping system for reheater/superheater attemperation, HP - LP bypass system and auxiliary PRDS system;
 - 6) Condensate piping system;
 - 7) Condenser make up water system;
 - 8) Heater drains and vents piping including necessary flash tanks;
 - 9) Steam drains including necessary flash tanks;
 - 10) Valve gland sealing piping system;
 - 11) Miscellaneous line drains and vents including necessary flash tanks;
 - 12) Complete safety valve exhaust piping for safety valves on steam generator, HP piping, Auxiliary PRDS, heaters and deaerator etc.;
 - 13) Startup vents, safety valves, pneumatic relief valves (PRVs), flash tanks and all vents from the respective equipment and pipes up to a level of one meter above the boiler house/ TG building roof. Silencers shall be provided for startup vents, lowest safety valve and PRVs. All drains from respective equipment and pipelines shall be connected to the drain manifold of the flash tanks;
 - 14) Complete chemical dosing system piping;
 - 15) Any other piping system to make the power cycle piping complete; and
 - 16) Complete steam blowing piping including target plates and chemical cleaning of piping including provision of temporary piping as required. Piping systems shall be complete with fittings/accessories, specialities, blow-down valves, vent valves, drain valves and safety valves along with their escape piping, drain piping and steam traps, expansion joints, insulation, hangers, supports, restraints/guides, snubbers and auxiliary steel etc. The drain system shall be complete along with drain pipes, unit flash tank, drain valves, root valves, relief/safety valves, control valves, motorised valves, gate/ globe valves, non-return valves, break-down orifices, steam traps etc.
- j) Power cycle control valves shall include
- 1) De-superheating spray water control valves for superheater, reheater and auxiliary steam supply;
 - 2) HP heaters normal and emergency level control valves;



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 3) LP heaters normal and emergency level control valves (For LP1 heater, the arrangement shall be as per manufacturer's standard practice);
 - 4) BFP recirculation control valves;
 - 5) Deaerator level control valves;
 - 6) Deaerator pressure control valves;
 - 7) Condensate recirculation flow control valves;
 - 8) Condenser normal make up control valves;
 - 9) Condenser emergency make up control valves;
 - 10) Feed water control valves;
 - 11) Condensate recirculation control valve;
 - 12) Excess condensate dump control valve;
 - 13) Deaerator overflow control valve;
 - 14) The power cycle control valves shall be complete along with suitable type of bypass valves. Each control valve shall be provided with arrangement of upstream and downstream isolation valves (upstream pneumatically/ electrically operated and downstream manual) with motor operated inching type bypass valve. All other control valves not specifically included above but required for completeness of the system shall also be in the scope of the bidder.
- k) Chemical dosing system
- 1) All volatile Treatment (AVT) system complete unloading, storage, handling, measuring, dilution and metering systems for feed water chemical dosing including but not limited to unloading stations, day tanks, capacity measuring tanks, capacity preparation / dosing tanks, metering pumps, dosing pumps complete with strainers, piping, valves, fittings, manifolds, hand pumps, safety showers, eye wash, instrumentation and control panel, including oxygen cylinders with dosing skids.
- l) Condensate polishing unit (CPU)
- 1) Complete Condensate Polishing Plant including filters, mixed bed unit, regeneration unit, piping, valves, and instrumentation. The CPU shall be provided with associated chemical feed system for storing, preparing, measuring and dosing the required chemicals and with its external regeneration system, DM regeneration water tank, Effluent disposal system, central DCS, for control and monitoring.
- m) Steam and Water Sampling system (SWAS)
- 1) Complete steam and water sampling system including sampling racks, sample coolers, pressure reducing devices, piping, valves and required instruments and Analyzers, Central DCS for control and monitoring.



n) Industrial Gas Cylinders

- 1) Adequate nos. of gas cylinders along with manifold station for various industrial gases (hydrogen, carbon dioxide, nitrogen) shall be supplied.

o) Miscellaneous

- 1) Chemical cleaning of all equipment and systems after their erection shall be in Bidder's scope.
- 2) Thermal insulation and removable metal cladding shall be provided for all the equipments, piping and piping support frames as required.
- 3) Necessary blanking arrangements required to protect the valves and turbine internals and other auxiliaries during steam blowing shall be provided.
- 4) All oils, chemicals etc. to waste shall be routed to a common collection tank (to be supplied by the Bidder) individually identified by the Employer for oil or any such obnoxious material which cannot be put into the plant drainage.
- 5) Suitable HOT/Electric Monorail hoist cranes along with runway/monorails beams and approach ladders and/ or platform of adequate capacity to meet the need for erection, operation and maintenance.
- 6) Operating platform around the deaerator, GSC, flash tanks, lube oil/ control oil tanks, HP/LP bypass valves, Emergency Stop Valves / Intercept valves, local platforms for various inaccessible valves and equipments, all Electrical and Pneumatic Valve Actuators etc. shall be in bidder's scope.

2.16.03 ASH HANDLING SYSTEM

i) Bottom Ash Handling system

- a) 3- V shaped water impounded bottom ash hopper completed with discharge gate, seal trough arrangement, refractory lining , refractory cooling arrangement, overflow arrangement, access door, inspection windows, poke holes, supporting structures, platform, stairs and all accessories, etc.
- b) Two (02) nos. of Clinker Grinder on each V of bottom ash hoppers
- c) One (01) no. of Jet pumps for each clinker grinder
- d) Bottom ash slurry transportation pipe line along with fittings, valves and supports from Jet pump to ash slurry sump
- e) Bottom ash overflow sump along with 2x100% bottom ash over flow pumps
- f) Bottom ash slurry Pipe line along with fittings, valves and supports from bottom ash overflow pump to dewatering bin.
- g) Three (03) dewatering bins completed with discharge gate, overflow arrangement, decanting system, pipeline valves etc. Each dewatering bin shall have three outlets.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- h) Three (03) nos. discharge gate and vibrating feeder for each dewatering bin. One vibrating feeder will be used for unloading of bottom ash in open truck and two vibrating feeder will be used for discharging of bottom ash in belt conveyors
- i) 2 X 100% belt conveyor stream completed with idlers, belts, pulleys, short supports, stringers, belt cleaners, chute works, etc. from dewatering bin to ART tank
- j) One no. bottom ash crusher for each belt conveyor stream
- k) One no. vibrating feeder for each belt conveyor stream
- l) Two (02) nos. of motorized plough feeder for each belt conveyor stream
- m) One (01) no. settling tank and one (01) no. surge tank along with supports, piping and all accessories
- n) Three (03) series of Ash slurry pumps along with valves piping etc.
- o) Pipe line from Ash slurry sump up to Ash dyke area along with valves
- ii) Coarse Ash handling system
 - a) One (01) no. manual hopper isolation valve below each economizer, APH and duct ash hoppers
 - b) One (01) no. Pneumatic operated valve below each hopper isolation valve
 - c) One (01) no. flushing apparatus below each economizer, APH and duct ash hopper
 - d) Ash slurry pipeline along with fittings, valves and supports from flushing apparatus to bottom ash hopper
- iii) Fly Ash handling system
 - a) One (01) no. manual hopper isolation valve below each ESP ash hoppers
 - b) One (01) no. pneumatic operated material inlet valve below each ESP ash hoppers
 - c) 2 x 100% Vacuum pumps for each vacuum conveying stream (Ash conveying pipe line) along with vacuum air pipeline line, valves, fittings and supports
 - d) One (01) no. buffer hopper along with bag filter for each vacuum conveying stream
 - e) Vacuum conveying streams (Ash conveying pipeline along with valves, fittings and supports) from ESP hoppers to buffer hoppers
 - f) Two (02) nos. fluidizing air blower along with heater and fluidizing air pipeline, valves and fittings for ESP hopper fluidization
 - g) Two (02) nos. of ash vessels completed with vent connection, pneumatic panel, buffer hopper isolation valve material intake valve etc. below each buffer hoppers for conveying of fly ash from buffer hoppers to fly ash silos along with Pressure conveying streams (Ash conveying pipelines along with valves, fittings and supports) from buffer hoppers to fly ash silo

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- h) Five nos. (3W+2S) screw type transport air compressors and Five (05) nos. refrigerant type Air dryers along with air pipeline, valves, fittings and supports
- i) Air receivers for transport air compressors
- j) Two nos. (1W+1S) screw type instrument air compressors and two (02) nos. refrigerant type Air dryers along with air pipeline, valves, fittings and supports
- k) Air receivers for instrument air compressors
- l) One no. (01) wetting unit below each buffer hoppers
- m) One (01) no. Jet pump common for two nos. of buffer hoppers
- n) Ash slurry pipeline from jet pump to ash slurry sump
- o) Two (02) nos. Fly ash silo along with vent filter; each silo shall have six nos. of outlet. One outlet for unloading of ash through rotary feeder and ash conditioner to open truck in conditioned form, two outlets for unloading of ash through rotary feeder and telescopic chute to ash bulker in dry form, two outlets for HCSD system and one outlet is blanked with isolation valve for future use
- p) Two (02) nos. fluidizing air blower along with heater and fluidizing air pipeline, valves and fittings for fluidization of each silo
- q) Two nos. (1W+1S) screw type instrument air compressors and two (02) nos. refrigerant type Air dryers along with air pipeline, valves, fittings and supports for silo area
- r) Air receivers for instrument air compressors for silo area
- iv) HCSD system
 - a) Two (02) nos. Fly ash feeder for feeding fly ash from fly silo to ART for each fly ash silo
 - b) One (01) no. Agitation retention tank (ART) with motorized agitator and all accessories for each HCSD pumps
 - c) Three (03) nos. (2W+1S) Charge pumps along with all accessories
 - d) Three (03) nos. (2W+1S) HCSD pumps along with all accessories
 - e) One (01) nos. HCSD pipeline up to Ash dyke area along with valve, fitting and supports for each HCSD pumps
- v) Ash Water system
 - a) Two (02) nos. of Economizer water pumps with all accessories
 - b) Two (02) nos. of LP water pumps with all accessories
 - c) Two (02) nos. of HP water pumps with all accessories
 - d) Two (02) nos. Fly ash water pumps
 - e) Two (02) nos. HCSD water pumps
 - f) Two (02) nos. Ash conditioner water pumps



- g) Two (02) nos. of Seal water pumps with all accessories
- h) Water pipeline along with valve, fitting and supports
- vi) Process control equipment's along with complete instruments and interfacing to Central Unit DCS shall be provided as specified in relevant C&I portion of the specification.
- vii) One set of additional hot redundant controller with I/O cards and complete hardware & Software etc. shall be provided with Central Unit DCS for monitoring of AHP (Ash Handling Plant) system.

2.16.04 MATERIAL HANDLING PLANT

i) *Coal Handling Plant*

- a) Two (02) nos. (1W+1S) Wagon tippler along with all accessories
- b) Two (02) nos. (1W+1S) Side Arm charger along with all accessories
- c) Double stream (1W+1S) Trough Belt conveyor complete with pulleys, idlers, take-up arrangement, deck plate, seal plate, short support, stringer, belt cleaners, thruster brakes, belt switches, belt, conveyor galleries, trestles, transfer tower, Crusher and Screen house including Screens and Crushers etc. from wagon tippler hopper discharge up to boiler bunker also including Trippers and up to yard conveyor.
- d) Single stream trough Belt conveyor complete with pulleys, idlers, take-up arrangement, deck plate, seal plate, short support, stringer, belt cleaners, thruster brakes, belt switches, including Stacker cum Reclaimer, belt, conveyor galleries, trestles, etc for stacking of coal after Crushing
- e) Single stream trough Belt conveyor complete with pulleys, idlers, take-up arrangement, deck plate, seal plate, short support, stringer, belt cleaners, thruster brakes, belt switches, gates, vibrating feeders, belt, conveyor galleries, trestles, etc for reclaiming of coal from coal stock pile
- f) Single stream trough existing Yard conveyor complete with modification for receiving coal from the existing yard conveyor, pulleys, idlers, take-up arrangement, deck plate, seal plate, short support, stringer, belt cleaners, thruster brakes, belt switches, gates, vibrating feeders, belt, conveyor galleries, trestles, etc for reclaiming of coal from existing coal stock pile up to underground transfer point near WT.
- g) One (01) no. reversible stacker cum reclaimer completed with rails and rail drive mechanism, boom, bucket wheel and bucket wheel drive mechanism, boom conveyor, tripper, structures etc. for stacking / reclaiming of coal
- h) Two (02) nos. (1W+1S) Wagon Tipplers with Side Arm Charger and with all accessories
- i) Two (02) nos. (1W+1S) Vibrating Grizzly deck screens with all accessories
- j) Two (02) nos. (1W+1S) Crushers with all accessories
- k) Two (02) nos. (1W+1S) Apron feeders and dribble conveyors below each wagon tippler.
- l) Two (02) nos. (1 no. In each WT) EOT crane of 40T.



- m) All Vibrating feeders
- n) Rod gates, Flap gates and Rack & Pinion Gates
- o) All chute works
- p) Plain water dust suppression system for Coal stock pile completed with tanks, piping and valves and sprinklers
- q) Dry fog dust suppression system for all wagon tippler complex, transfer towers and crusher house completed with tanks, pumps, compressors, nozzles, piping and valves
- r) Dust extraction system for all transfer house, transfer towers and crusher house completed with compressors, bag filters, vent fans, ducting and dampers
- s) Tunnel ventilation system completed with fans, ducting and dampers
- t) Bunker ventilation system completed with compressors, bag filters, vent fans, ducting and dampers
- u) All Metal detectors and ILMS
- v) All belt weighers and In-motion weighing scale for wagons
- w) One (01) no. Crusher house
- x) All Transfer towers with maintenance hoist for each equipment/accessories
- y) All Emergency Recalim Hoppers

2.16.05 FLUE GAS DESULPHURISATION SYSTEM

- i) Complete flue gas desulphurisation system as mentioned in the specification, Including
 - a) Ducting work completed with expansion joints, gates and dampers, duct supports, etc.
 - b) Thermal Insulation and Cladding
 - c) Wet limestone forced oxidation type absorber completed with oxidation tanks, agitators, etc.
 - d) Slurry Recirculation Pumps completed with piping and spray headers, etc.
 - e) Three stage Mist Eliminators along with mist eliminators washing system
 - f) Absorber Oxidation System completed with oxidation air blowers, oxidation lances, oxidation air humidification system, piping & Valves, etc.
 - g) Auxiliary Absorbent Tank completed with agitator, pumps, piping and valves, etc.
 - h) Gypsum Bleed pumps along with piping and valves, etc.
 - i) Emergency quenching system completed with tanks , piping and valves, etc.



- j) Limestone Slurry Preparation and Storage system completed with limestone silos, feeders, wet ball mills, mill circuit tanks, mill circuit pumps, Hydro cyclones, limestone slurry storage tank, piping and valves
- k) Limestone Slurry Supply Pumps, piping and valves etc.
- l) Gypsum Dewatering System completed with hydro cyclones, vacuum pumps, vacuum belt filters, storage tanks, agitators, pumps, piping and valves
- m) Waste Water System completed with waste water neutralization system, pumps, piping and valves
- n) Process and Clear Water Tanks & Pumps
- o) Gypsum Handling System completed with Gypsum conveyors, trippers / plough etc.
- p) Sump Pumps, agitators, piping and valves, etc.
- q) Wet Chimney

2.16.06 LIME HANDLING SYSTEM

- i) Totally covered Lime Unloading Facility (from Trucks), including -
 - a) Unloading Hoppers
 - b) Truck Tipplers with platform for tipping of trucks, Rod gates, Rack & Pinion gates and Vibrating feeders, separate dedicated DE system for unloading facility
- ii) One no. electronic weigh bridge (60T) shall be provided.
- iii) Limestone Conveying system shall consists of high angle belt conveyors, belt conveyors, belt feeders, reversible belt feeders, Bucket Elevator, Belt weighers, Metal detectors, ILMS / CBMS, Tramp iron chutes (to discharge tramp iron to ground), Flap gates (for diverting and interconnection), interconnecting chutes, Dust extraction (DE) system for conveying system
- iv) Lime stone crushing system, including Grizzly deck vibrating screens and Crushers, interconnecting chutes and DE system in Crusher house.
- v) Limestone Storage system including, limestone storage silos, Rod gates, Rack & pinion Gates, Vibrating feeders/Bin Feeders, belt feeders, weigh feeders, interconnecting belt feeders, interconnecting chutes and DE system.
- vi) Sump pumps
- vii) Suitable Dust extraction system in limestone storage shed/limestone silos and limestone bunkers
- viii) Radar (Radio Frequency) 3D level with display and control for all each silos
- ix) All Chute works for transfer of limestone with liner on all wearing surface with all sides welded and provided with countersunk bolt of hexagonal head (Allen key removable). The size of the liner shall be maximum 500X500 mm.



- x) Necessary lifting equipments (Chain pulley blocks, manual/electrical hoist, cranes) of adequate capacity and type for maintenance of the equipments wherever required.

2.16.07 CIRCULATING WATER SYSTEM

Supplies and services under CW system are as follows:

- i) CW Channel, Fore-bay and CW Pump House
- ii) 3 x 50% Circulating Water Pumps along with drive motors, discharge piping, valves, hydraulic packs, rubber expansion joints, etc.
- iii) 1 no. Start-up ACW pump of adequate capacity & head.
- iv) Stop log gates and Screens as required for the pumps.
- v) 3 X 50% Auxiliary Cooling Water (Booster) Pumps along with drive motors, discharge piping, valves, electric actuators, REJs etc.
- vi) 2x100% Automatic self-cleaning filters in the ACW circuit.
- vii) Complete CW & ACW system piping
- viii) CW model studies
- ix) CW transient analysis
- x) CW treatment systems as per technical specification
- xi) All integral and interconnecting piping including pipe fittings, valves, stubs for instrumentation, pipe supports, specialities etc.

2.16.08 COMPRESSED AIR SYSTEM

- i) Compressors
 - a) 'N_{IA}' Working + one (1) Standby skid mounted, oil free, water cooled, rotary screw or centrifugal compressors of adequate capacity and discharge pressure to meet instrument air (IA) requirements of the complete 1x800 MW power plant, except CHP dust suppression system & AHP.
 - b) 'N_{SA}' Working + one (1) Standby skid mounted oil free, water cooled, rotary screw or centrifugal compressors of adequate capacity and discharge pressure to meet service air (SA) requirements of the complete 1x800 MW power plant, except AHP.
 - c) Compressors shall include the following minimum accessories:
 - 1) Air intake filters
 - 2) Silencer
 - 3) Inter cooler for multi-stage compressor complete with trap station with bypass arrangement.
 - 4) After cooler complete with trap station with bypass arrangement.
 - 5) Sound proof enclosure



ii) *Air Drying Plant*

- a) 'N_{IA}' Working + one (1) Standby Heat of Compression (HOC) Rotary drum type or conventional twin tower type air-dryers (with specified margin), to match instrument air compressor capacity, along with all accessories including control panel, flow meter, online digital dew point meter at the outlet of each dryer, etc. 'Open through (Blower reactivated)' type ADP is also acceptable.
- b) A dew point analyzer shall be installed at the discharge of each air dryer to monitor the quality of instrument air delivered from the system.
- c) Air drying plants will be interconnected with operation of selection valves from DCS

iii) *Air Receivers*

- a) Air receivers of minimum 10m³ capacity to hold air and minimize pressure fluctuations for each compressor near compressor house.
- b) Additional air receivers of similar/adequate capacity shall be provided different locations shall be provided based on layout, process requirements and as specified.
- c) Instrument air and service air receivers shall be provided along with all accessories such as pressure gauges, safety relief valves, electronic type auto drain traps, manual isolation / blow off auto drain valves, bypass control valve, fittings, temperature indicators, transmitters, etc.
- d) Air receivers shall also be interconnected with operation of selection valves from DCS

iv) *Miscellaneous*

- a) Complete piping (integral and interconnecting), fittings, couplings, expansion joints, valves, gates and supports/hangers, required for the plant compressed air system including distribution network and ring header.
- b) Isolation valves for individual equipments
- c) Cooling water system
- d) All filters/strainers, intermediate and terminal air receivers, etc.
- e) Under-slung EOT cranes to handle all equipments in the system.
- f) Complete instrumentation required for both local and remote monitoring, process control and performance evaluation for all process parameters.

2.16.09 AIR CONDITIONING AND VENTILATION SYSTEM

i) *Air Conditioning for Main Plant and Control Building*

- a) 1x100% Vapour absorption machine (working) and 1 x 100% Screw chilling machine (standby) complete with all accessories as described here in after.
- b) 1 no. of PRDS for regulating the steam parameter as per VAM operating requirement.



- c) Two (2) Nos. Back pull out or Horizontal Split Casing Centrifugal Condenser Water Pump Sets (1W + 1SB) each complete with all accessories as described here in after. These pumps shall be common for 1 x 100% VAM working and 1 x 100% standby screw chilling machine.
- d) Two (2) Nos. Back pull out or Horizontal Split Casing Centrifugal Chilled Water Pump Sets (1W + 1SB) each complete with all accessories as described here in after. These pumps shall be common for 1 x 100% VAM working and 1 x 100% standby screw chilling machine.
- e) Two (2) Nos. Fibre glass reinforced plastic (FRP) construction Cooling Towers (1W + 1SB) each complete with all accessories i.e. fan, motor, FRP basin, nozzles, level switch, make up connection, drains, piping, valves & fittings, strainer, ladder and supporting structure etc. The capacity of the cooling tower shall be equal to the condenser cooling capacity. These cooling towers shall be common for 1 x 100% VAM working and 1 x 100% standby screw chilling machine.
- f) DCS based control, common for AC Plant.
- g) Air Handling Unit (AHU) / Fan Coil Units (FCU) as below:
 - 1) Three (3) nos. (2W and 1S) sheet metal cabinet type (double skin) air handling units of sectionalized construction each complete with all accessories, to match the AC load of Central Control Room, Control Equipment Room, Computer Room etc at operating level of TG Building.
 - 2) Two (2) nos. (1W + 1S) sheet metal cabinet type (double skin) air handling units of sectionalized construction each complete with all accessories, to match the AC load of 24V DC Charger & DCDB and UPS etc.
 - 3) Two (2) nos. (2 no working) FCU, to match the AC load of Dry Room etc at 0.0 M level of TG Building.
- h) Pan type humidifier in each AHU room and Electric Strip heater shall be provided in common supply air ducting from AHU's for monsoon reheating or winter heating purpose.
- i) One Lot of Pre-filters (inside the pre-filter section of the AHUs)
- j) One Lot of Fine filters (shall be provided in Common discharge of AHUs).
- k) Condenser Water Piping
 - 1) One Lot of condenser water piping interconnecting condensers, cooling tower, pumps etc. complete with strainers, valves, fittings etc. Black steel pipe conforming to IS-1239, Part I, heavy grade or IS-3589 (6mm thk) depending upon pipe size shall be used.
 - 2) The piping up to 100 mm dia shall be galvanized steel and those above 100 mm black steel.

I) *Chilled Water Piping*

- 1) One Lot of chilled water piping with insulation and cladding, interconnecting chiller, air-handling units and pumps sets complete with valves and fittings etc. Black steel pipe MS ERW conforming to IS-1239, part I, heavy grade or IS-3589 (min. 6mm thk) depending upon pipe size shall be used. The piping up to 100 mm dia shall be galvanized steel and those above 100 mm-black steel.
- 2) One No. MS / FRP chilled water expansion tank (of minimum 1m³ capacity) complete with valve, Level Gauge, Level Switches, Make-up connection, overflow and drain etc. The tank shall provide with level gauge glass and shall be completely insulated.
- m) One Lot of Drain water piping out of MS pipes conforming to IS-1239, Part I, heavy grade and galvanized as per IS:4736, from various equipments like chillers, pumps, AHUs, cooling tower area etc. up to the nearest drain point. (Within the room & for Cooling tower up to nearest drain point or rain water pipe on the roof) with Thermal insulation.
- n) One No. Make up water tank made of MS / FRP complete with valves, level gauge, level switches, make up connection, over flow and drain etc.
- o) One nos. Storage water tank (8m³ capacity) made of MS complete with valves, level gauge, level switch, make up connection, over flow and drain etc. This tank will supply make-up water to cooling towers, expansion tank and humidifier.
- p) Fire Dampers - The supply and return air ducts shall be provided with motor operated fire damper at locations where duct pass through walls & floors for ease of isolation, maintenance fire protection purpose & should also be possible to operate manually and as well as for emergency operation. The operation of these automatic dampers shall be interlocked the fire alarm system.
- q) One Lot of GSS Ducting (as per IS-277) with 200 g/m² or better of zinc coating sheet metal work including thermal insulation on complete supply air duct & return air duct (as applicable) and acoustic insulation for initial length of 6m from the AHU outlet.
- r) 2x100% Water Softening Plant complete with all accessories with pump, valves, piping, fitting etc.
- s) 1x100% Duty fresh air fan with pre-filter & fine filter in all AHU Rooms.

ii) *Air Cooled Precision Package Air-Conditioning Plant*

- a) 3x50% or 2x100% Air Cooled Inverter Package AC will be used for each area; as mentioned the technical specifications.
- b) 1 Lot of Fine filters (shall be provided in common discharge of each Precision AC).
- c) 1 Lot of Copper piping with insulation for interconnecting indoors unit, outdoors units etc.



- d) 1 Lot of PVC type Drain piping
- e) 1 Lot of GSS Ducting with 200 g/sqm or better of zinc coating sheet metal work including thermal insulation on complete supply air duct and acoustic insulation for initial length of 5m from the indoor outlet.
- f) Thermostat and dampers for each office room/zone.
- g) 1x100% Duty fresh air fan with pre-filter & fine filter in all Precision AC Rooms
- iii) *Ducted Split Air-Conditioning Plant*
 - a) Ducted Inverter Split AC will be used for each area; as mentioned the technical specifications.
 - b) 1 Lot-Fine filters
 - c) 1 Lot of Copper piping with insulation for interconnecting indoors unit, outdoors units etc.
 - d) 1 Lot of PVC type Drain piping
 - e) 1 Lot of GSS Ducting with 200 g/sqm or better of zinc coating sheet metal work including thermal insulation on complete supply air duct and acoustic insulation for initial length of 5m from the indoor outlet.
 - f) Thermostat and dampers for each office room/zone.
- iv) *Split type Air-Conditioners*
 - a) Split type air conditioners (air cooled) are provided to cater to the air conditioning requirements with 3 x 50% or 2 x 100% or ('N'W + 1S) duty configuration; for all PLC and UPS areas, I/O panel rooms, SWAS Rooms, rooms associated with labs, stores etc. of the power plant, all control rooms in auxiliary plant areas; as mentioned in the technical specifications; where 'N' is the no. of working units.
 - b) For office cabin rooms, no standby unit is envisaged.
- v) Any other areas if requires air conditioned environment, shall be provided with suitable AC plant.
- vi) *Evaporative Type Ventilation System*
 - a) Adequate no. of Evaporative type ventilation system of adequate capacity, complete, with all accessories shall be provided for TG building unit.
 - b) Filtered and Cooled air from each air washer unit shall be distributed to various areas through diffusers.
 - c) The TG building shall be provided with adequate number of roof extractors of adequate capacity.
 - d) Air Washer system will include Fans, pumps, spray nozzles, moisture drift eliminators, distribution plates, Filters, louvers, associated piping, valves, fittings etc.

vii) *Unitary Air Filtration Ventilation System*

- a) Adequate no. of Unitary Air Filtration (UAF) system of adequate capacity, complete, including all accessories like fans, pumps, spray nozzles, louvers, moisture eliminators etc, using water repellent type nylon filters shall be provided for ESP/FGD buildings as applicable.

viii) *Pressurised Ventilation System*

- a) Centrifugal fans/ axial supply fans for various areas of the power plant, as mentioned elsewhere in this specification & the same shall be finalized based on the actual requirement during detail engineering.

ix) *Non-Pressurised (i.e. Negative) Ventilation System*

- a) Axial type exhaust fans for various areas of the power plant, as mentioned elsewhere in this specification & the same shall be finalized based on the actual requirement during detail engineering.

2.16.10 FIRE PROTECTION SYSTEM

i) *Fire Water Tank*

- a) One (1) no. RCC fire water tank as per relevant guidelines; however the effective capacity shall not be less than two hours' fire fighting water requirement of the largest fire hazard. This storage can be part of the Clarified water storage tanks as Dead Storage.

ii) *Pumps & Pump House Equipment*

- a) Three (3) nos. of electrically driven, centrifugal fire water pumps, of adequate capacity and head along with drive motors and all other accessories. However, actual requirement will be finalised during detailed engineering.
- b) Two (2) nos. of diesel engine, centrifugal fire water pumps, of adequate capacity and head along with ICE drive and all other accessories.
- c) Two (2) nos. of electrically driven, centrifugal fire water jockey pumps, of adequate capacity and head, along with drive motors and all other accessories.
- d) 2x100% hydrant booster pumps (1 no. electric driven and 1 no. Diesel engine driven), horizontal centrifugal pumps, of adequate capacity and head, as required, with all accessories as specified. However, minimum capacity shall be 171 m³/hr.
- e) Additional booster pumps any, as required, of adequate capacity and head.
- f) One (1) no. hydro-pneumatic tank of adequate capacity (min. 22.5 m³).
- g) 2x100% air compressors of adequate capacity and head.
- h) The quantity and capacity indicated in the specification is only minimum tentative and bidder to work out capacity and quantity based on guidelines.

iii) *Hydrant System*

- a) One lot of underground/ over ground piping work for stand posts and risers duly painted and complete with fittings & supports, above ground isolation valves
- b) One lot of hydrant valves for outdoors and indoors complete with all accessories.
- c) One lot of Water Monitors (where applicable) complete with isolation gate valves.
- d) One lot of 15m long hoses with male and female instantaneous couplings for external hydrants.
- e) One lot of 7.5m long hoses with male and female instantaneous couplings for internal hydrants.
- f) One lot of branch pipes and spray nozzles.
- g) One lot of fog type nozzles.
- h) One lot of M.S. painted Hose boxes complete with all accessories as per National Fire Protection Association (NFPA).
- i) One lot Fire hose reel set complete with valves, piping and pipe coupling.
- j) One lot of Air Release valves, drain valves, restriction, orifices
- k) One lot of nozzle with coupling

iv) *Spray System*

- a) One lot of underground / over ground piping work duly painted and complete with valves, fittings & supports.
- b) One lot of Deluge valves complete with trims, alarm motor and gong and piping.
- c) One lot of High velocity Spray Nozzles.
- d) One lot of Medium velocity Spray Nozzles.
- e) One lot of Quartzoid bulb detector

v) *Foam Protection System*

- a) One number 100% capacities Aqueous Film forming Foam (AFFF) foam tanks complete with first fill of foam, foam inductors, valves, piping and other accessories.
- b) One lot of foam makers complete with orifice plate, breather, foam pourer.
- c) One lot of deluge valves complete with all trims, alarm motor and gong
- d) One number Deluge valve local control panel.

vi) *Inert Gas System*

- a) Complete Inert gas system including storage containers, distribution network, discharge nozzles, pilot cylinders, gas releasing devices, control panels etc

vii) *Fire Detection and Alarm System*

- a) Latest microprocessor based addressable fire detection and alarm system including automatic fire alarm system devices like Multi sensor type detectors, photoelectric smoke detectors, rate of rise heat detectors, probe type heat detectors, Notification devices like electronic hooters, siren, hooter cum strobe, control and repeater panels, UPS etc
- b) Make of fire detection and protection system shall be same for all plant / BOP irrespective of sub contractor

viii) *Portable and Mobile Extinguishers*

- a) One lot of self Pressurized with cartridge operated water type water fire extinguishers of 9-liter capacity conforming International code.
- b) One lot Carbon dioxide type fire extinguishers of 4.5 kg capacity conforming to relevant International code.
- c) One lot of Carbon dioxide type fire extinguishers of 9 kg capacity conforming to relevant International code.
- d) One lot of Mobile carbon dioxide type fire extinguishers of 22.5 kg. Capacity conforming to relevant International code.
- e) One lot of Dry chemical powder store pressurized with cartridge operated type fire extinguishers 6 kg. Conforming to relevant International code.
- f) One lot of Dry chemical powder ABC type fire extinguishers of 2 kg capacity conforming to relevant International code.
- g) One lot of Dry chemical powder store pressurized with cartridge operated type fire extinguishers 9 kg. Conforming to relevant International code
- h) One lot of Dry chemical powder type fire extinguishers of 50 kg capacity (as per relevant International code)
- i) One lot of Foam type self Pressurized with cartridge operated fire extinguishers of 9-liter capacity conforming to relevant International code.
- j) One number. Mobile foam type fire extinguishers of 50-liter capacity conforming to relevant International code.

ix) *Fire Tender*

- a) One (1) no. Water fire tender with capacity of water tank 5000 litres. Complete with chassis, fire pumps, control panels, any other special requirements like high pressure reciprocating pumps, accessories and various types of advanced fire fighting accessories as per Annexure – I (Refer Part-A Section-11 Fire detection & Protection System).
- b) One (1) no. Foam cum water fire tender with capacity 4500 litres water and 500 litres foam tank complete with chassis, fire pumps, control panels, any other special requirements like high pressure reciprocating pumps, accessories and various types of advanced fire fighting accessories as per Annexure – I (Refer Part-A Section-11 Fire detection & Protection System).



2.16.11 HANDLING EQUIPMENT

i) *Electric Overhead Travelling (EOT) Cranes*

- a) Two (2) nos. Double Girder (DG) EOT cranes of adequate capacity for TG Hall
- b) One (01) no. DG EOT cranes of adequate capacity for BFPs (depending on layout)
- c) One (1) no. DG EOT crane for CW Pump House
- d) One (1) no. Single Girder (SG) Under Slung (US) EOT crane for each of following areas:
 - 1) Emergency DG set building
 - 2) Air compressor Building
 - 3) Mills (1 for each bay)
 - 4) ACW pump house
 - 5) Raw water pump house
 - 6) Clarified/Filter Water Pump House
 - 7) Fire Water Pump House
 - 8) Bottom ash Slurry pump house
 - 9) Ash water pump house
 - 10) Vacuum pump house
 - 11) Ash Slurry pump house
 - 12) Conveying air compressor house (if separate)
 - 13) HCSD Pump House
 - 14) FGD SRC Pump house
- e) 1 no. Semi-Gantry or Gantry crane for CW Pump house for handling screens and gates
- f) 1 no. EOT or Semi-Gantry / Gantry crane for Central Store
- g) Any other cranes required as per layout and system requirement
- h) EOT cranes (including gantry/semi gantry cranes) shall be complete with all accessories like:
 - 1) Complete crane structure
 - 2) All drive motors and driving gears.
 - 3) Runway rails for bridge and trolley including all clamps, anchors, bolts, nuts, shims, inserts, end stops and other fixtures.
 - 4) Operator's cabin



- 5) Portable carbon dioxide fire extinguishers are to be provided in the operator's cabin.
- 6) Runway conductors (D.S.L.) and power collectors complete with all supports, insulators, brackets, fixtures etc.
- 7) Complete Electrical works including main disconnect switch, all controls and interlocks including all supplies with necessary wiring, grounding, protective panels etc.
- 8) Limit switches for crane
- 9) Illumination
- 10) Suitable air conditioner Unit as well as Fan in operator's cabin
- 11) Spring / rubber buffers for end trucks.
- 12) Lifting lug, eye bolts etc. for handling the crane parts.
- 13) Protection guard as specified
- 14) Foot operated siren
- 15) Repair cage
- 16) All platforms, handrails and ladders as specified and as required.
- 17) Lifting hook block assembly.
- 18) Cranes electrical grounding system
- 19) Pendant Push button as well as Radio remote control for the cranes.

ii) *Electric/Motor Hoists with Trolleys*

- a) One lot of Electric Hoists, of adequate capacities, lift & travel; complete with trolleys, runway rails and all accessories; for all equipment, of the power plant, which are not covered/handled by any crane; and as required.
- b) Electric hoist has to be provided to handle all plant equipment (which is not covered by any crane) and which is One (1) ton and above OR if the height to which any equipment is to be handled is 10m and above. For balance equipment chain pulley blocks with travelling trolley & beam shall be provided.

iii) *Chain Pulley Blocks*

- a) One lot of Chain Pulley blocks, complete all accessories; minimum requirement is as follows:

Quantity (nos.)	Capacity (Ton)	Lift (m)
3	1	6
3	1	8

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

Quantity (nos.)	Capacity (Ton)	Lift (m)
3	2	6
3	2	8

iv) *Electric Powered and Diesel Powered Forklifts*

a) 2 Nos. 2T Electric Forklifts

b) 3 Nos. 5T Diesel Forklifts

v) *Miscellaneous handling Equipments*

a) One lot of miscellaneous handling equipment; minimum requirement is as follows:

Item	Quantity (nos.)	Capacity (Ton)
Hand Pallet Trucks	5	2
Battery Operated Pallet Trucks	2	4
Platform Trolleys	2	1
Platform Truck	2	2
Drum Trolley	3	0.3

2.16.12 ELEVATORS

i) *Passenger elevators as below:*

- a) One (1) no. Passenger Elevator, each suitable to carry thirteen (13) persons at a time, for Service Building
- b) One (01) no. Passenger Elevators for one for ESP Control Building & One for FGD control building suitable to carry eight (8) persons at a time,
- c) Passenger Elevator, suitable to carry eight (8) persons at a time, shall be provided for other buildings which has more than Ground plus two (2) floors or if floors are above 10m height (above ground floor level / FFL). If a passenger cum goods elevator is provided for that building, then separate passenger elevator is not required there.

ii) *Passenger cum goods elevator as below:*

- a) One (01) no. passenger cum goods elevators, suitable to carry minimum 2000 kg at a time for Power House Building.
- b) One (01) no. passenger cum goods elevators, suitable to carry minimum 3000 kg at a time for boiler.
- c) Passenger cum goods elevators, suitable to carry minimum 2000 kg at a time for Bunker building.



- d) One (1) no., passenger cum goods elevator, suitable to carry minimum 1088 kg at a time; one for each building/structure in FGD area, if height of operating floor/platforms (where personnel /goods approach is required for O&M) is more than 10m from ground floor/FFL.
 - iii) One (1) no. Rack and pinion type elevator for Chimney
 - iv) CHP structures - One for crusher house and one for transfer tower as mentioned in Material handling specification.
 - v) Other elevators as mentioned in the technical specifications and as required.
- 2.16.13 COOLING TOWER (NDCT)
- i) One (1) number of reinforced concrete double curvature hyperbolic shell (hyperboloid in vertical section, circular in plan), as per functional requirements and the specification, complete with –
 - a) Raker columns
 - b) Ring beams
 - c) Foundations
 - d) Cold water basin with partition walls
 - e) Hot water ducts
 - f) Drain sumps with Valves
 - g) External drain chamber with associated pipe work
 - h) Cold water channels with sluice gates and removable screens as specified elsewhere
 - i) CW Channel to CW Pump house
 - j) Hoists & monorails
 - k) Primary and secondary hot water distribution troughs,
 - l) Water distribution pipes and nozzles
 - m) Fills
 - n) Fill support systems including structures, columns & beams
 - o) Drift eliminators and supports
 - p) External/Internal stairs and cage ladders
 - q) Winches of minimum 200 kg capacity, to access top of NDCT.
 - r) Handling facilities at tower top with walkway platform
 - s) Platforms, walkways as specified or required for operation and maintenance



- t) Access doors
 - u) GI handrails
 - v) Steel fittings, fixtures, inserts including fabrication, galvanizing and erection of associated steel work and painting etc
 - w) Earthing, lightening arrestors, aviation warning/ lighting system etc.
 - ii) Testing of cold water basin for water tightness
 - iii) Two (2) nos. (1W+1S) sludge pumps (submersible type) of minimum 200m³/hr capacity and adequate head complete with drive motors, valves, piping, fittings, supports etc. for cold water basin drainage for cooling tower. The bidder shall terminate pump discharge pipe work at inlet clarifier/filtration system (WTP) sludge pit& CMB.
- 2.16.14 Plant water System
- i) Complete Plant Water System as mentioned in the detailed specifications, meeting the requirements of the plant. Plant Water system will include –
 - a) Raw Water (RW) Intake System
 - 1) Modification of existing CW pump house (CWPH) of de-commissioned units 1 & 2, along with the intake channel from Left Bank Canal.
 - 2) Rectification and restoration of existing CW pump house, which will herein-after be referred as Raw Water Intake Pump House (RWIPH)& Channel for the new plant/pumps, taking into consideration –
 - New Pumps
 - New Screens & Gates
 - New Ventilation System
 - New EOT Crane
 - 3) One (1) set of Trash Racks along with its Trash Rack Cleaning Machine (TRCM), along with all its accessories.
 - 4) One (1) of Screens, for each pump sump, along with all its accessories.
 - 5) One (1) of Stop log gates, for each pump sump, along with all its accessories.
 - 6) Three (3) Nos. Vertical type Centrifugal Raw Water Intake Pump Sets (2W + 1SB) each complete with all accessories as described in the specification.



b) Pre-treatment (PT) System

- 1) One (1) no. flow control station consisting of a (inching type) motorised flow control valve (FCV), its isolation valves and a bypass valve to FCV, to control water flow to clarifier.
- 2) One (1) no. Stilling Chamber with baffle and retention time of one (1) minute. Drain to be connected to sludge sump.
- 3) 1x100% or 2x50% Flash mixer with agitator and retention time of one (1) minute. Drain to be connected to sludge sump.
- 4) 1x100% or 2x50% Clarifiers complete with all its accessories and sludge blow-off, disposal and flushing arrangements.
- 5) Complete new chemical dosing arrangements of adequate capacity, for Clarifiers, complete with all adequate accessories, including –
 - 2x100% Measuring/dosing tank for each chemical, along with agitator.
 - 3x50% dosing pumps, for each chemical.
 - Dosing system can be common for both clarifiers.
- 6) Complete sludge handling system
- 7) One (1) Chemical House (two storied) for housing chemical solution tanks and pumps, along with centrifuge (at 1st floor); complete with material handling facilities.
 - Chemical storage arrangement shall be provided for 30 days requirement.
 - One (1) platform digital type weighing scale of 500 kg capacity.
 - Electric hoists of minimum 2 ton capacity
 - ♦ For handling chemical at ground floor &
 - ♦ For handling chemical at 1st floor
 - One (1) centrifuge at 1st floor.
 - A toilet block shall also be provided at the ground floor.
- 8) In case gravity filters are being selected over pressure sand filters, four (4) working and two (2) standby Rapid Gravity filters along with all accessories shall be provided, after clarifier, along with clarified water storage tank.
 - 2x100% Air Blowers



- Arrangement for Back Wash of Pressure Sand Filters, including water storage tank and 2x100% Back-wash pumps.
- 9) One (1) Clarified water storage tank cum fire water tank, in two compartments, along with -
- Isolation valves/gates for each compartment
 - Overflow and drain arrangements
- 10) Level indicator and transmitters.
- c) Demineralised (DM) Water Treatment System
- 1) 2x100% DM Filter Feed Pumps
- 2) 2x100% Pressure Sand Filters with all accessories (in case PSF is opted over gravity filters)
- 2x100% Air Blowers
 - Arrangement for Back Wash of Pressure Sand Filters, including water storage tank and 2x100% Back-wash pumps.
- 3) 2x100% Activated Carbon Filters with all accessories
- 4) 2x100% Weak Acid Cation Exchanger with all accessories
- 5) 2x100% Strong Acid Cation Exchanger with all accessories
- 6) Degassing System
- Degassing system, complete with all adequate accessories, including –
 - ◆ 2x100% Degasser tower
 - ◆ 2x100% Degassed water storage tanks (DGWT)
 - ◆ 2x100% Degassing Blowers
 - ◆ 2x100% Degassed water tank pumps
- 7) 2x100% Weak Base Anion Exchanger with all accessories
- 8) 2x100% Strong Base Anion Exchanger with all accessories
- 9) 2x100% Mixed bed Exchanger with all accessories
- 10) 2x100% Air Blowers for Mixed Bed Exchanger
- 11) Complete Acid & Alkali Handling Storage and Regeneration System, including tanks, pumps etc.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- Two (2) nos. stations for unloading each chemical, along with two (2) nos. 80 NB rubber hose & connection.
- 2x100% Chemical unloading/transfer pumps for each chemical
- 'N' Working + one (1) Standby Bulk Storage Tanks, for each chemical
- 2x100% measuring/dosing tanks for each chemical, along with agitator for alkali/caustic dosing tanks
- 2x100% Ejectors or dosing pumps for each chemical. One for each dosing tank.
- 2x100% Regeneration pumps
- 2x100% Air blowers
- One (1) no. Brine Preparation tank with injection pumps
- One (1) Regeneration Water Heater, Hot Water Tank, as required for anion resins
- One (1) no. Alkali Filter
- 1 no. twin chamber RCC Neutralising pit (N-Pit), complete with all adequate accessories, including -
 - ◆ 1x100% measuring/dosing tank for each chemical, along with agitator for alkali/caustic dosing tank
 - ◆ 2x100% dosing pumps, for each chemical.
 - ◆ 2x100% N-Pit recirculation cum transfer pumps
 - ◆ 2x100% N-Pit air blowers.
 - ◆ Chemical resistant tiles

12) Two (2) nos. DM water storage tanks.

d) DM water Transfer System

1) 3x50% DM water transfer pumps, of adequate capacity & head.

e) Cooling Water (CW) Make-up System

1) 3x50% CW transfer/make-up pumps, of adequate capacity & head.

f) Service Water (SW) System



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 1) 3x50% service water (SW) (VFD) pumps, of adequate capacity & head, to maintain service water pressure in the SW network.
 - 2) 2x50% expansion tank, on the service water pumps discharge header.
 - Alternatively – 1 lot of Overhead Tanks.
- g) Potable Water (PW) System
- 1) 2x50% Chlorine & Lime dosing arrangement.
 - 2) 3x50% potable water (PW) (VFD) pumps, of adequate capacity & head, to maintain service water pressure in the PW network.
 - 3) 2x50% expansion tank, on the potable water pumps discharge header.
 - 4) Alternatively – 1 lot of Overhead Tanks.
- h) FGD Clear Water Supply System
- 1) 2x100% FGD Clear Water Supply Pumps, of adequate capacity & head.
- i) APH/ESP Wash Water Supply system
- 1) 2x100% APH/ESP Wash water supply pumps, of adequate capacity & head.
- j) Effluent Treatment Plant (ETP)
- 1) One (1) no. effluent collection pit/tank (RCC) of adequate capacity, at respective effluent collection locations.
 - 2) 2x100% sump pumps (submersible), of adequate capacity and head, at respective effluent collection sump/pit at various locations in the plant.
 - 3) One (1) no. common effluent collection pit/tank (RCC) of adequate capacity.
 - 4) 2x100% common effluent transfer pumps, of adequate capacity and head.
 - 5) 1x100% Oil Water Separator (RCC chamber), with skimming arrangement, of adequate capacity.
 - 6) Arrangement to collect oil from OWS in Drums as well as to transfer collected oil to Common Sludge Collection Sump.
 - 7) One (1) no. Flash mixer (RCC chamber), of adequate capacity, along with 1x100% agitator.
 - 8) One (1) no. Flocculator (RCC chamber), of adequate capacity.
 - 9) One (1) no. Lamella clarifier (RCC chamber), of adequate capacity.
 - 10) Complete chemical dosing arrangements of adequate capacity, for ETP clarifier, complete with all adequate accessories, including –
 - 1x100% measuring/dosing tank for each chemical, along with agitator.
 - 2x100% dosing pumps, for each chemical.



- 11) One (1) no. RCC Central Monitoring Basin, of adequate capacity, complete with all adequate accessories including -
 - Four (4) nos. Isolation gates for the CMB compartments; two (2) at the inlet sump and two (2) at the outlet sump.
 - 3x50% treated effluent (TE) (VFD) pumps, of adequate capacity & head, to maintain treated effluent pressure in the TE network.
 - 2x50% expansion tank, on the treated effluent pumps discharge header.
 - 12) 2x100% Boiler blow-down transfer pumps, of adequate capacity and head.
 - 13) 2x100% CT blow-down (booster pumps), of adequate capacity and head, if required.
 - 14) One (1) no. RCC CT blow-down tank, of minimum one (1) hr. Capacity.
 - 2x100% FGD process water supply pumps, of adequate capacity and head to transfer CT/CW blow-down water to Process water tank in FGD area.
 - 2x100% AHP water supply pumps, of adequate capacity and head to transfer CT/CW blow-down water to Ash water tank in AHP area.
 - Additional pumps if any, as per system requirements.
 - 15) Complete Sludge Treatment System including -
 - 2x100% PT Clarifier sludge pumps, of adequate capacity from pre-treatment system sludge collection pit to common sludge sump/pit.
 - 2x100% ETP Clarifier sludge pumps, of adequate capacity from ETP sludge collection pit to common sludge sump/pit.
 - One (1) common sludge sump of effective capacity 250 m³.
 - 2x100% Sludge thickener feed pumps, of adequate capacity from common sludge sump/pit to Sludge Thickener.
 - Sludge Thickener
 - 2x100% Sludge centrifuge feed pumps, of adequate capacity from common sludge sump/pit to Sludge Thickener.
 - Sludge Centrifuge
 - One lot of sludge flushing and recirculation arrangement, including 2x100% Recovered water transfer pump.
- k) Sewage Treatment Plant (STP) including
- 1) One (1) no. RCC Sewage collection pit
 - 2) One (1) Screen Chamber and Adequate no. of Screens



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 3) One (1) no. Oil & Grease (O&G) O&G Trap Tank with oil pipe skimmer
- 4) One (1) no. Grit Tank
- 5) One (1) no. Equalisation Tank
- 6) 2x100% Sewage Transfer Pumps
- 7) 2x100% Air Blowers
- 8) One (1) no. Moving Bio Bed Reactor (MBBR) Tank with One (1) lot of Floating Media
- 9) One (1) no. Hypo Dosing Tank
- 10) 2x100% Hypo Dosing Pumps
- 11) One (1) no. Secondary (Lamella) Clarifier
- 12) One (1) no. Chlorine Contact Tank
- 13) One (1) no. Clarified Water Tank
- 14) 2x100% Filter Feed Pumps
- 15) One (1) no. Pressure Sand Filter
- 16) One (1) no. Activated Carbon Filter
- 17) One (1) no. Treated Sewage Collection Tank
- 18) 2x100% Treated Sewage Transfer Pump
- 19) Sewage Sludge Handling System
 - One (1) no. Sludge Holding Tank
 - 2x100% Sludge pump
 - One (1) no. Poly Dosing Tank
 - 2x100% Poly Dosing Pumps
 - One (1) no. Filter Press
- 20) One (1) no. UV Sterilisation System
- 21) One (1) no. pH Control Dosing Tank
- 22) 2x100% pH Control Dosing Pumps
- l) Complete chemical lab including all instrument and equipment to monitor and control the water, coal and oil parameters shall be provided, including furniture. Refer Annexure-I of PWS Specification.
- m) Miscellaneous

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 1) Any item, which might have been inadvertently missed from above, but is required to complete the system, to meet its intended purpose.
- 2) One (1) lot of piping, valves, fitting and supports to complete the plant water system within terminal points, including SW, PW & TE distribution network.
- 3) Intermediate tanks as required.
- 4) One (1) no. Central Sampling Rack for DM plant, located at the Central Laboratory.
- 5) Bypass and recirculation arrangements with quick selection/isolation valves.
- 6) Filter media, resin, and degasser tower packing for all the units complete with make-up filter media, resin and packing for first year of operation. Quantity of make-up resins shall be calculated on the basis of 3% and 5% attrition loss per annum for cation and anion resin respectively. For filter make-up a loss of 10% per annum shall be considered.
- 7) All pumps shall be complete with drives, base plates, couplings, guards, fasteners, anchor bolts. Strainers (Suction), suction and discharge valves and associated instrumentation will also be part of the pump assembly.
- 8) Stainless steel agitator, complete with drive, shall be provided for chemical dosing/measuring tanks, wherever required.
- 9) One (1) no. safety eye wash & shower with necessary valves and piping near each chemical handling area.
- 10) Isolation valves for individual equipments.
- 11) Overhead cranes in raw water pump house and clarified water pump house.
- 12) Hoists to handle all other equipment in the plant water system.
- 13) Handling arrangements in chemical store room.
- 14) Complete lab instrument and equipment required for monitoring and to control the water quality, shall be provided.
- 15) Instrumentation and control system, including instruments, analysers, interlocking and protection devices, accumulators, complete in all



respects required for safe, efficient and reliable operation of the system.

16) Complete instrumentation required for both local and remote monitoring, process control and performance evaluation for all process parameters.

17) Additional requirement if any to meet the commissioning requirement of the plant has to be arranged by the Bidder.

2.16.15 ELECTRICAL

- i) The below are the major electrical equipment's/components considered under electrical system scope of work, however it is not limited to the below, any other electrical equipment and components required for successful supply, erection, commissioning and operation of the plant shall also be considered under the scope. Also please refer the detailed electrical systems scope of work as specified in Volume III – Part B electrical part.
- ii) 400kV (GIS) Gas Insulated switchyard and 400KV AIS extension of 2 complete bays with the existing 400KV AIS.
- iii) Generator – Generators and its accessories (seal oil system, gas system, cooling system, excitation system, automatic voltage regulator), auto synchronizers, generator control / metering and protection panels.
- iv) Isolated Phase Bus Duct - Isolated Phase Bus Ducts including pressurization system (along with required seal off bushing at A row wall, wall frame assembly at floor crossings) between Generators and Generator Transformers, delta connection of single phase GTs, tap-off to UTs and excitation transformer (static excitation system), LAVT cubicle and CTs for generator phase-side, neutral side and on tap off to UTs, generator neutral formation earthing cubicle (NGT & NGR).
- v) Power Transformers – Generator Transformers (GTs), Station transformers (STs), Unit Transformers (UTs) complete with remote OLTC Control Cabinet/OCTC (as applicable), all fittings and accessories. During transportation Bidder shall supply impact recorders on returnable basis for each power transformer. The recorder shall be taken back only after obtaining written permission from owner's Site In charge. All the transformers control, metering and protection panels shall also be supplied under the scope of bidder.
- vi) Bidder has to consider necessary loads on TG building 'A' row / any other row as per design requirement for stringing the overhead conductors from 400KV switchyard to GT and ST.
- vii) Auxiliary Power Transformers – 11/6.9kV , 11/3.45kV transformers for feeding supply to auxiliary loads of the plant complete with all fittings and accessories.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- viii) Service Transformer (LV Transformer) -11/0.433 kV transformers for feeding supply to LV auxiliary loads for the complete plant. Transformers shall be Dry type (AN) for indoor locations and ONAN for outdoor application.
- ix) Neutral Earthing equipment – Earthing resistors for 11 kV & 6.6 kV , 3.3kV and 415V system neutrals to limit the earth fault current to 300 A (maximum) for short duration. For 415V, the earth fault current shall be limited to 400A for 10 secs.
- x) HV Switchgear (11 kV and 6.6/3.3 kV) - complete with breakers, bus bars, Instrument Transformers, Relays, Meters, terminal blocks, Dummy Panels, Bus Trunking & accessories for unit & station including SCR, FGD, CW pump house, Compressors, coal handling plant, Ash handling plant etc.; and any other system/packages considered in mechanical scope of work. In 11kV Unit switchboard fast bus transfer scheme shall be provided for restoration of supply from 11kV station Switchboard in case of supply failure from the respective unit transformer. Manual/Auto live changeover with check synchronization as well as automatic Slow Changeover facility shall be provided as a backup. 11kV station Switchboard shall have Auto/Manual live changeover provision. All 6.6 kV Switchgears to be provided with Manual/Auto closing of bus coupler and Manual/Auto live changeover with check synchronizing and other synchronizing equipments. Owner's feeders and any other feeder requirement shall be provided, as indicated in the Key SLD. The check synchronizing relay shall be housed in the respective switchboards or the relay shall be part of ECP (i.e. common for 11kV, 6.6/3.3 kV & 415V systems.).The numerical relays used for protections of incomers shall not be used for synchronisation / paralleling. Separate check synchronisation relay with its hard ware based logics and interlocks for auto changeover of the systems shall be provided. Provision of two trip coils with individual trip circuit for all HT switchgear breakers shall be considered. A marshalling module shall be provided on each bus of HV Switchgear for interfacing with DCS. Control of incomers and bus-coupler breakers of HV switchgear shall be possible from the ECP/DCS in Main Plant Area.
- xi) LV Switchgear (415V)complete with breakers / contactors, bus bars, Instrument Transformers, Relays, meters, terminal blocks, Dummy Panels, Bus Trunking (subject to Owner's approval) & accessories for catering the loads of unit and station including FGD, SCR, CW pump house, Compressors, Mill reject system, Elevators, Cranes, HVAC, Fire protection system, Fuel Oil transfer &pressurising, water system, DM plant, coal handling plant, Ash handling plant etc; and any other systems/packages considered in the mechanical scope of work. All 415 V PCC/PMCC/MCC to be provided with Manual/Auto closing of bus coupler and Auto/Manual live changeover with check synchronizing. A marshalling module shall be provided on each bus of LV Switchgear for interfacing with DCS. Control of incomers and bus-coupler breakers of LV switchgear shall be possible from the ECP/DCS in Main Plant Area. The check



synchronizing relay shall be housed in the respective switchboards except for the Turbine PMCC & Boiler PMCC (For these two panels the relay shall be part of ECP). Dummy panels shall be integral part of the LV Switchgear and of same size. Bidder to provide feeders for owner's use as per Key SLD.

- xii) Segregated Bus Ducts – Segregated Phase Bus Duct (SPBD) between UTs & 11 kV Unit Switchgear, between ST and 11 kV station switchgear, ties between station and unit switchgear and between Auxiliary Power Transformers & 6.6/3.3 kV Switchgear with required bends, supporting structures with related civil work. Phase Cross over, if required in 11kV/3.3kV shall be accommodated at the switchgear end in the rear dummy panel. Segregated Bus Ducts will be of aluminium alloy conductor in aluminium alloy enclosure. The conductor shall be of high conductivity aluminium / aluminium alloy sized for the same rating as associated PCC/PMCC bus. For rating above 2000A conductor shall be copper.
- xiii) Non-Segregated Bus Ducts – Non-segregated Bus Duct (NSPBD) between 415 V Service Transformer to LV service PCC/PMCC for the plant with required bends, supporting structures with related civil work. Phase Cross over, if required in 415V systems shall be accommodated at the switchgear end in the rear dummy panel.
- xiv) Local Control Panel/JB/PBs- Local Control panels for all auxiliaries and power supply arrangement, JBs as required for all systems and local stop PB stations for all unidirectional motors and bidirectional drive motors (except for MOV), DC starter panels etc..
- xv) Motors- Drive motors (AC & DC) for all rotating mechanical equipment of the plant as required. Motors with VFD where ever required as per Technological requirement shall be supplied.
- xvi) Actuators- All motor driven actuators of the plant shall be Non integral type.
- xvii) VVFD – HT & LT Variable Voltage Frequency drives as per the system requirement.
- xviii) Cable & Cable Carrier System- HV/MV/LV Power, control, fire survival and special cables along with cable raceway system with necessary fire barriers, fire proof sealing and coating systems, Cable supporting structures, cable trenches (only in Switchgear rooms & locally (maximum 5.0 metres) near the equipment), cable racks, cable trays, conduits, cable laying and cable termination, termination kits. Cable trenches shall be avoided in main BTG area switchgear and control buildings, cable cellar shall be considered.
- xix) DC System- 220 V DC systems complete with Batteries (Plante type/Ni-Cd)), Float and float-cum-boost chargers, Battery racks, Battery MCBs with BMS system, Distribution Board for the complete station loads.
- xx) Diesel Engine Alternator (DG system)–Two (2) number (1W,1S) of DG set of Min 2000kVA rating complete with all accessories including AMF panels, DG set



panels, Emergency board/MCC for the complete plant. In addition Two (2) numbers of DG sets (1W,1S) of minimum 750kVA rating complete with all accessories including AMF panels, DG set panels, Emergency board/MCC for the FGD system.

- xxi) Earthing and Lightning protection- For the entire plant area in the plant complete with earth grids and electrodes buried in soil in the plant area, embedded in concrete inside the buildings to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons. Lightning protection complete with vertical air termination rods, horizontal roof conductors, down comers, test links and pipe electrodes for the complete plant area/buildings. Treated earth pits are to be provided for transformer neutral earthing, electronic earthing, LA & CVTs. Required number of risers shall be provided at each location/elevation. Advanced type charge Accumulation Device (SERTEC) shall be applied for only buildings against lightning protection. However, the advanced technology shall be discussed during detail Engineering and shall be acceptable only if it is agreeable/approved from customer upon submission of credentials.
- xxii) Illumination system - shall include lighting transformers, MLDB, ELDB and DCLDB, ACN/ACE/DC lighting panels, Lighting masts, poles, lighting fixtures, lamps, internal street/road lights, Power sockets, high mast towers approx. 6 nos.etc. for the entire plant.
- xxiii) Telephone system – complete with EPABX & its accessories required for the complete plant. IP based Public Address (PA) system for whole plant shall also be provided.
- xxiv) Welding sockets, including welding transformers & Welding PCC and power supply network.
- xxv) Electrics (cables, earthing & power supply arrangement) associated with Hoisting & handling system for the entire plant.
- xxvi) Electrics (cables, earthing & power supply arrangement) associated with all equipments and auxiliaries.
- xxvii) Waste water & oily waste- from soak of GT, ST, UT& UAT shall be collected in burnt oil pit. Similarly burnt oil pit shall also be provided in Bunker/mill area if required.
- xxviii) Two Nos. portable pumps shall be supplied to transfer oily waste to common oily pit (TPI separator) located in ETP area for further treatment.
- xxix) In drives, whenever bigger size Multi run Power cables are envisaged, power JB's for terminating the power cables shall be used. Unarmoured copper flexible cable shall be used between power JB and the motor terminal box. This flexible copper cable shall be routed in GI conduit or suitable mechanical protection shall be provided.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

xxx) Rail tracks for movement of GTs, STs UTs & UATs in the transformer yard for taking the transformers to maintenance bay / till the periphery road located in the Power Plant building. Common fencing has to be provided for GT & UT and separate fencing has to be provided for ST & UAT in the transformer yard.

xxxii) Complete civil works like transformer foundations with soak pits, fire protection walls for all Transformers.

xxxii) Complete civil works like cable trenches with cover, pavements, drainage arrangement to a Burnt Oil pit to be provided within the transformer yard for GTs, STs, UTs& UATs.

xxxiii) Construction power supply distribution

xxxiv) ELECTRICAL ERECTION AND TESTING – Installation, testing and commissioning of all the electrical equipments but not limited to Generator, IPBD, GT, ST, UT, UAT, Neutral Earthing equipment, SPBD, NSPBD, DC System, Switchgear (HV and LV), Motors (HV, MV and LV), Service transformers (LV Transformers), DG sets, Auxiliary steam boiler, Fuel forwarding/pressurising systems, communication systems etc. with all the equipments are in the scope of Bidder.

xxxv) Mandatory spares as given in elsewhere.

xxxvi) Any other electrical equipment required to complete a functional, reliable operating plant.

xxxvii) Electrical equipment & systems integral with mechanical equipment, systems and subsystems, even if not specifically referred to shall also be provided as per relevant sections of mechanical specifications and shall be included in the scope of Bidder. In the absence of any stipulation in the mechanical specifications, such equipment and systems shall be supplied as per applicable clauses of the electrical specifications, proven engineering practice and applicable codes and standards.

xxxviii) Electrical Lab equipments

xxxix) For whole plant buildings, all panels and switchgears should be kept at 1st floor, above cable floor which will be at the ground level.

xl) Roof top Solar system of adequate capacity shall be installed at various buildings of plant and connected to nearby 415V MCC

2.16.16 CONTROL AND INSTRUMENTATION

i) The Contractor shall provide all required Control & Instrumentation system for control, monitoring and operation of entire plant including all the systems, equipment etc covered under various sections of these specification (like Mechanical sections for SG/TG/Auxiliaries/BOP, Offsite etc, Electrical sections for Generator/MCC/SWGR/ Transformer etc.), in all regimes of operation in safe



and most efficient manner. The Contractor shall also provide all material, equipment and services which may not be specifically stated in the specifications but are required for completeness of the equipment/systems furnished by the Contractor and for meeting the intent and requirements of these specifications. The work shall be consistent with modern power plant practices and shall be in compliance with all applicable codes, standards, guidelines and safety requirements in force on the date of award of the contract. The requirements of statutory Authorities (e.g. MOEF, Inspector of Factories, IBR,TAC,PCB/SPCB/CERC etc with regard to various plant areas like main plant, Fuel Oil Plant/System, Chlorinating Plant, Fire fighting system, Emission & effluent measurements etc.)shall be complied even if not actually spelt out.

- ii) The instrumentation and control (I&C) system called for in the specification shall be a comprehensive system integrating the functions of plant monitoring, control and protection of the total power plant, to facilitate the task of integration, co-ordination and autonomous operation of the plant sub systems/equipment namely Steam Generators (SG), Steam Turbine Generator (STG) and their associated auxiliaries, Balance of the plant equipment / systems, plant electrical system of the unit.
- iii) Further, Bidder shall also include in his proposal and shall furnish all equipment, devices and services which may not be specifically stated in the specification but are needed for completeness of the equipment/systems furnished by the bidder and for meeting the intent and requirements of the specification.
- iv) All electrical devices like switches/ transmitters/ controller/ analyzer/ solenoid valves which are located in the in hazardous areas like hydrogen gas area, seal oil area etc. shall be made intrinsically safe by providing suitable type of transformer isolated barrier / Zener barrier of standard make & shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I or EN60079-14 or shall comply with the essential requirements of ATEX directives.
- v) State of the art Distributed Control System (DCS) of uniform hardware complete with controller, I/O modules, Remote I/O cabinets, data highways, operator stations with visual display units and control devices, Printers, engineering stations, supervisors console, historical storage unit, necessary application, diagnostic and engineering software, , Sequence of Events Recording system, Large Video Screen (LVS) Displays, pre-fabricated cabling interconnecting the DCS system equipment, control desks with all operational hardware required for emergency operation from control room control desk, system cabinets, marshalling cabinet, facility for remote connectivity etc. for safe & efficient operation / monitoring and control (both auto control and protection logic controls) of entire plant and associated systems as specified in detailed specifications of C&I section Vol-III Part-C



- vi) Process control equipment's along with complete instruments and interfacing to Central Unit DCS shall be provided as specified in relevant C&I portion of the specification.
- vii) Two separate dedicated PC shall be considered in CCR with suitable interface with AHP and CHP DCS for remote monitoring.
- viii) For certain auxiliary plants, viz. Coal Sampling Unit, Stacker Reclaimer, Wagon Tippler and Automatic Sprinkler System Programmable Logic Controller (PLC) based control system shall be provided. Suitable hardware/software for interfacing of Coal sampling PLC control system with /CHP DCS shall be provided for monitoring from CHP control room. DCS architecture is to be provided by the bidder. For certain systems where PLC is integrally mounted on the equipment. Remote/long distance PLC communication with Central DCS shall be wireless. This shall be finalized during detailed engineering.
- ix) The complete control & instrumentation system shall be furnished, erected and commissioned and all other services shall be performed by the bidder as covered under this specification including FAT, SAT and this work shall be fully in compliance with the requirements stated herein in the specification for following equipments/systems/subsystems and shall not be limited to the following:-
 - a) Integrated Distributed control System (DCS) with PDB panels, marshalling cabinets, printers with operating stations and engineering stations, Servers etc for closed loop control, open loop control, operation, monitoring, controls, interlocks & protection, sequence control and bulk data acquisition system, analysis, report with work stations, Large video screens (LVS), hardwired visual alarm/annunciation system and any other proprietary control system are under bidder scope.
 - b) DCS system including hardware and software, data bus system, interconnecting cables and devices, sequence of event recording, master and slave clock system, historical storage & retrieval system, alarm management system, engineering & diagnostic system, smart transmitter maintenance system, OPC servers, firewall, performance calculations & optimization package, interface relays for signal exchange with electrical system, barriers, printers, and gateways and links for interface with third party systems etc are under bidder scope as specified in relevant section of the specification. The separate earth system for DCS to be provided with copper bus. Bidder shall also consider DCS Configuration drawing as given in Volume III of the Specifications.
 - c) Boiler & Auxiliaries related control & instrumentation system such as BMS, boiler protection system, Soot blower system, Feeder controls, bunker level & CO gas monitoring, Electromagnetic safety valve, Furnace temperature probe, furnace flame monitoring/ scanning and analysis system, Automatic



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

steam leak Detection System, Acoustic furnace Temperature Measurement system, emission (equipments/system) control system, start up fuel oil system, dosing system, Metal Temperature measurement, fuel oil control system, other mechanical & auxiliaries systems, etc are under bidder scope as specified in relevant section of the specification.

- d) TURBINE Generator & Auxiliaries related control & instrumentation system such as Turbine protection System, Turbine Governing System, over speed protection system, bypass control system, Automatic Turbine Run-up System, Automatic turbine tester, lube oil system, jacking oil system, Turbine stress evaluator, EH oil system, Turbine Supervisory system with analysis package and turbine Generator integral instruments, turning gear, gland sealing system, auxiliary PRDS control, air cool condenser system, regenerative system, other mechanical & auxiliaries systems, etc as are under bidder scope specified in relevant section of the specification.
- e) The above system(s) shall include their respective measurement system for signal acquisition, conditioning and signal distribution of various types of inputs/outputs, meeting specification requirements including respective Hardware requirements as stipulated in -DCS Vol-III Part-C of Technical Specification.
- f) Bidder shall be responsible for engineering, selection and connection of all components and sub-systems to form a complete system whose performance is in accordance with functional, hardware, parametric and other requirements of this specifications. It is not the intent or the purpose of this specification to specify all individual system components since the Bidder has full responsibility for engineering and furnishing of a complete system.
- g) Large Video Screen min (80") with controller, GPS Master Clock, CCTV Monitoring Systems is under bidder scope as described in various sections of the specification are under bidder scope as per Vol-III Part-C of Technical Specification..
- h) Plant view & Management Information System server for MIS function, Computerized Maintenance Management System (CMMS) server for plant asset management, plant-wide network with user terminals etc are under bidder scope.
- i) All measuring Instruments, field instruments viz. smart transmitters (HART protocol), diaphragm pressure gauges, pressure transmitters, temperature transmitters, thermocouple, RTD, metal temperature measurement, process switches, gauges, flow / level indicators, sensors, converters, analyzers, skid mounted instruments, Local field instruments etc. along with all accessories, sensors, flow elements, radar type level transmitter, ultrasonic type level transmitter etc. with all accessories and platforms.



- j) All primary flow elements with branch pipes, along, root valves, flanges, nuts, bolts, gaskets and accessories, magnetic flow meters, mass flow meters with totalizer, Vortex flow meters, venture tube, ultrasonic flow-meter, annular, aerofoil, Rota-meter etc.
- k) Final control elements, control valves with actuators, damper with actuators, motorized/pneumatic/hydraulic actuators, on/off valves with actuators, power cylinders. All pneumatic control valves and dampers along with actuators, smart pneumatic positioners, limit switches, hand wheels, solenoid valves, position transmitters and accessories.
- l) Impulse pipes, (IBR & non IBR, plastic coated/ without coating SS 316 /Copper tubing), stub, tubing, pneumatic tubes along with required fittings and isolating valves, fittings, Junction boxes, instruments valves manifolds, isolating and drain valves, air supply pipes/ tubes, gauge valves, condensate pot, fittings, stands, brackets, Local instrument enclosure, local instrument rack etc.
- m) Supply, Cabling, Wiring & Termination of instrument & control cables, Thermocouple extension cables, Instrumentation pair & control cable, power cable, optical fiber cable, special cables, pre-fabricated cable, junction boxes, cable trays, sub-trays/perforated tray, tray covers, raceway, supports, cable glands, Lugs, ferrules, conduits, tray covers, inspection covers, pull boxes, bends, elbows, mounting brackets, clamps, nuts and bolts, connectors, markers, sub-tray supports, rigid conduits, tie wraps etc (irrespective of the one end or both end in their scope) for the total package.
- n) All instrumentation cables (twisted & shielded, PVC insulated & sheathed with FRLS properties) thermocouple extension cables (PVC / extruded FEP insulated & sheathed) and prefabricated cables (with plug-in connectors), Control Cables, Power Supply distribution cables, armored optical fiber cables without flexible / metal conduit as applicable for interconnection of all equipment/system/devices DCS/PLC/MCC/LT SWGR/HT SWGR/ etc. shall be applied,terminated and laid by the contractor on as required basis.
- o) Separate cables are to be provided for dual / triple redundant instruments used for protection of Unit and HT drives. These cables are also to be laid in separate routes to the extent feasible.
- p) Instrumentation cables for PA system, AHP conveyor system and Coal Handling plant area shall be armoured.
- q) Heat resistant instrumentation cable shall be provided for all instruments / equipments / drives / devices located in hot areas such as Burner tilt, Hot

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

air gates, Air Heater areas , Furnace areas , Steam Drain & Vent Valves , Turbine – Generator areas, Oil system, HP/LP BP areas etc.

- r) All special & optical fiber cable for data acquisition from third party control systems and electrical control system including gateway and links.
- s) Supply of all consumables, tools and tackles, all start up and commissioning spares, instruments etc and obtaining all statutory clearances.
- t) Panel mounted instruments like indicators, ammeters, voltmeters, push buttons etc required for total package.
- u) All control room panels, operator's terminals, control panel/desk, work station consoles, marshalling/termination panels, interposing relay panels, system panels cabinets, power distribution panel, local push button stations, local control panel, furniture etc required for total package. All control panels height, width and color shall be identical throughout the plant and BOP system.
- v) Complete Steam and Water Analysis System (SWAS) with dry and wet panel, stainless steel sampling line or better, sample conditioning system, analyzers, indicators, recorders, grab sampling system, annunciator, water analyzer etc. as required for total package.
- w) Complete flue gas analyzers including continuous emission monitoring system / instrument, suspended Particulate Matter (SPM) / dust analyzer, in-situ zirconium type oxygen analyzers, CO,CO₂ analyzer, Sox analyzer, Nox analyzer and any other analyzer as per latest CPCB / GPCB for their on line pollution monitoring guideline. Real time data of above analysers shall be displayed at main gate of plant or LVS.
- x) Complete Ambient Air Quality Monitoring System (AAQMS) (minimum at four locations), climatic & meteorological monitoring system.
- y) All Gauge Boards, local Panels, local instrument enclosure for Boiler side, local instrument rack for turbine side (both enclosure and rack type shop manufactured), stanchions, brackets, canopy etc.
- z) All erection hardware including junction boxes, pull boxes, canopies, structural steel items viz steel angles, channels, flats.
- aa) Local Instruments Enclosures (LIE), Local Instrument Racks (LIR), Process connection & piping including all impulse piping, sample piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories required for proper installation & completeness of impulse piping system, sampling piping system and air supply system shall be provided by the Contractor on as required basis.



- bb) Complete cable accessories inclusive of all flexible conduits, sub-trays/perforated tray, tray covers, inspection covers, bends, elbows, mounting brackets, clamps, nuts and bolts, glands, lugs, ferrules, connectors, markers, rigid conduits, tie wraps, panel/cabinet frame supports, air purging system, optical fibre cable terminators, taps, optical fibre distribution box, patch cord / pigtail, light interface unit, heavy duty conduit etc.
- cc) Vibration / Machine condition monitoring system for all HT drive & driven equipment including all monitors, servers with on line decision support and analysis system and required cabinets, cable including optic fiber /special cable & accessories. Make of VMS shall be same for whole plant auxiliaries. VMS must install & commissioned before first trial run of each respective auxiliaries.
- dd) Parallel Redundant Uninterruptible Power Supply (UPS) System including redundant batteries for powering Instrumentation and Control System including DCS. Distribution and conversion of Power supply to all instruments, panels, consoles, MCB/MCCB, ACDB, DCDB, fuse, isolation transformer, voltage conversion and power distribution system are under bidder scope. The battery and battery charger shall be in the scope of the supply.
- ee) Bidder shall supply & set up Instrument workshop with all necessary maintenance testing, calibrating equipments & C&I lab /workshop instruments etc.
- ff) Special maintenance, calibration, commissioning, site testing and troubleshooting equipment required for the Distributed Control System & other bidder supplied system.
- gg) Supply of all start-up, commissioning and recommended mandatory spares
- hh) Complete grounding and electronic earthing system.
- ii) Rating plates, Nameplates and Labels for all I & C items.
- jj) Supply of all performance test instruments and analyzers.
- kk) Performance Test, Trial Operation and Guarantee Test.
- ll) Engineering documentation, Engineering Drawings, documents, Software's licensed and development tools, data, instructions, operation and maintenance manual etc. for Owner's review/approval/record.
- mm) Training of Owner's Personnel.
- nn) Bidder shall be responsible for software licensing, design, development, debugging, system engineering, customizing, installation, site modification,

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

tuning, adjustments, commissioning and furnishing manuals, documentation etc.

- oo) Any other item/ instruments / equipment not mentioned and covered herein but required for successful installation and commissioning of complete functional I&C system shall be included by the bidder in their scope.
- pp) It is not the intent or purpose of this specification to specify all individual system/components since the bidder has full responsibility for engineering and furnishing of total system.

2.16.17 CIVIL

- i) The scope of work covered herein include all planning, collection of all site related data, conducting site investigations, development of loading drawings, design and detailed engineering, preparation of all construction and fabrication drawings, supply of all labours and materials, construction, fabrication, erection and testing where necessary, of all structures required for housing all equipment and civil works for all services required for the plant defined in the bid specification. The civil works shall include all those items required for installation, commissioning, testing, operation and maintenance of the proposed plant.
- ii) Entire civil work including design, supply and construction for all buildings, structures, technological structures and facilities for all production, auxiliary units, foundations for all buildings, structures and equipment, roads, ramps, paving, parking areas, storm water drainage and sewers and all other miscellaneous civil engineering work as will be necessary for completing the 1 x 800MW plant on a turnkey basis within the plant.
- iii) Site related investigations: Topographical survey and detailed Geo technical Investigations works shall be carried out by bidder. Area drainage study to be done if required. No extra claim will be allowed because of any change with respect to soil investigation or any other input shared by Owner and that of actual investigations during detailed engineering and execution.
- iv) Site development works: Site clearance including bushes cutting if required, site grading, roads, drainage and cross drainage works, including temporary roads/drains, if required.
- v) Excavation in soil and rock (if any, with or without blasting as per the site conditions), dewatering, dressing to required profile, sheet piling or shoring/strutting, backfilling with CNS (Cohesive Non-Swelling) soil and compaction as per IS code wherever required around completed structures and plinth filling, piling, plinth protection, import soil from barrow pits, disposal of surplus earth and rock as directed by Engineer, concreting including providing reinforcement and formwork, fabrication, erection & painting of all structural steel and miscellaneous steel (i.e. steel stair case, cable/duct/pipe supports, pipe racks, ladders, walkways, hand railings, chequered plate/grating floor, inserts, anchor bolts, etc.), masonry work, vibration isolation system for machine foundations if required, plastering, painting, floor finish, doors, windows, & ventilators roofing including permanent steel decking, flooring, acid and alkali resistant lining, fire proof doors, electrically/mechanically operated rolling shutters, under deck insulation, false ceiling, roof water proofing, , paving, gravel

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

filling, precast covers, trestles, cable/pipe trenches/duct, expansion & construction joints, rain water pipes, water supply, toilet/washroom fittings, lift-well, sewerage, roof insulation, damp proofing, water proofing of underground structures, anti-termite treatment, cutting of existing roads and making good, drainage, roads, rail track, fencing, final grading including micro grading and site clearance before handing over and other auxiliary items of work, setting up of material testing laboratory to carry out relevant tests at site, safety, security, testing and commissioning etc. complete.

vi) Dismantling of buried/semi-buried structures, if any, encountered within the plant limits.

vii) GREEN INITIATIVES BY GSECL:-

a) The successful bidder shall have to supply 10 (ten) nos. of tree plants for every 1 (one) Crores Rupees of total contract value. Bidder shall have to supply, plant and take care (i.e. tree guard installation, regular watering etc.) of tree plants up to completion of E&C work. The supplied tree plant shall be of mango tree, neem tree, banyan tree, peepal tree, gulmohar tree (royal Poinciana), garmalo (golden shower) tree, deodar tree, ashoka tree, saag tree, sandal wood, sheesham (indian rose wood) tree, jamun tree, chickoo, guava, custer apple. The said tree shall be planted at the place (land) as per instruction of station head.

viii) The scope shall also include for dismantling of complete two Nos. of mound (i.e. Bholasingh Tekri & Hussain Tekri) in proposed plant area of coal stock yard and GIS area etc. up to existing plant and dismantling of existing bund at Ash-dyke – A. The dismantled material from these areas shall be used for filling of the 1 x 800 MW plant area (ash dyke –A). The handling and transportation of the dismantled material from these areas is also under the bidder's scope of work.

ix) Balance ash in the proposed plant area shall be completely removed by the Bidder.

x) The plant area shall be filled and developed up to finished ground level. Filling materials are available inside the plant boundary. Dyke wall of ash dyke shall be used for filling. There are two mounds (i.e. Bholasingh Tekri & Hussain Tekri) in proposed plant area of coals stock yard and GIS area. The contractor shall be excavated the soil from mounds and use for backfilling of proposed plant area, if found any rock boulders the same shall be crushed/broken for use of backfilling. if it is required to bring soil from outside for backfilling work, it will be under bidder scope..

xi) All debris from the plant site, including material removed during site cutting/grading and dismantled buried/semi-buried structures etc, shall be disposed-off by the bidder at his own cost, including transportation and arrangement of site for disposal. Proposal for this disposal shall be approved by owner/engineer.

xii) Earthwork for buildings and equipment foundations, trenches, pits, sewers and other construction work.

xiii) Back filling, soling and sub-grade work for all foundation, grouting, flooring, trenches, pits and other underground structures.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- xiv) Encasing structural steel column bases as well as wall beams with RCC at the locations of sun shade sills and other locations as required.
- xv) Concrete and reinforced concrete work in sumps, pits, trenches and other underground structures.
- xvi) All masonry work in sub structure and super structure including plastering as required.
- xvii) All finishing work to flooring, walling, ceiling, false flooring and false ceiling as required.
- xviii) All finishing and painting work to masonry, concrete structures, steel works and wood works.
- xix) All fencing and gates as required.
- xx) Doors, windows, ventilators, rolling shutters, fire check doors, gates shutters etc.
- xxi) All necessary technological and equipment supporting structures.
- xxii) Hand railing, inserts, kerb angles, bolts etc.
- xxiii) Separate ladies and gents toilets in all buildings.
- xxiv) Pantry and dining space with wash basin shall be provided in all buildings.
- xxv) The scope shall cover but not limited to complete civil, structural and architectural works for the following items/buildings/structure/systems/facilities and foundations and all associated equipments/structures of these.
 - a) Construction enabling works
 - b) Steam Turbine Generator building
 - c) Control room / Electrical bay structures
 - d) Foundations for Steam generator / ESP / Duct supporting structures as well as foundations for all equipments.
 - e) Fan foundations (PA, FD, SA and ID)
 - f) CEP foundations
 - g) TDBFP and MDBFP foundations
 - h) Foundations and Supporting structures for FGD and SCR systems.
 - i) Mill and Bunker building including bunkers and Mill foundations.
 - j) Mill reject system
 - k) Steam Generator elevator supporting structure
 - l) ESP & FGD Control / Switch gear rooms
 - m) RCC Chimney (Wet stack)
 - n) Steam generator & ESP area paving
 - o) Transformer foundations and structures, fire wall, fencing, tracking foundations, burnt oil pit, trenches and bus duct supports
 - p) 400kV GIS Building



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- q) Equipment foundations, trenches and trestles for GIS system.
- r) Transformer (Reactor) foundation, etc.
- s) Condenser cooling water system including CW pump house, fore-bay, CW channels, switchgear room, CW pipe encasement and thrust blocks.
- t) Necessary Civil works for Concrete volute for CW pumps
- u) ACW Pump house
- v) Natural Draft Cooling Tower (NDCT)
- w) Air Washer Building
- x) Compressor house
- y) Diesel generator house
- z) AC/Ventilation plant
- aa) Service building
- bb) CPU system foundation and structures
- cc) Store building including open storage yard
- dd) Crusher house
- ee) Coal transfer towers
- ff) Coal storage shed including paving, drainage system, etc.
- gg) Watch towers –5 nos.
- hh) Wagon tippler hopper complexes
- ii) Wagon tippler control room
- jj) Conveyor tunnel and pent house
- kk) CHP control building
- ll) Intake water channel and intake water pump house
- mm) Pre treatment plant building and control room
- nn) Clarifiers
- oo) Clarified water storage tanks
- pp) DM plant building and control room
- qq) Ash water pump house
- rr) Ash slurry sump and pump house
- ss) HCSD pump house
- tt) AHP control building
- uu) Pipe and cable racks/pedestals/trenches
- vv) Tank foundations
- ww) Foundations for Absorber, Aux. Absorber, etc.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- xx) Duct supporting structures and foundations for FGD system
- yy) Slurry recirculation pump house
- zz) Oxidation blower house
- aaa) Sumps / pits for FGD system
- bbb) CEMS room
- ccc) Gypsum dewatering building
- ddd) Lime storage silo
- eee) Mill building
- fff) Lime unloading area and storage shed
- ggg) Lime handling system
- hhh) Gypsum storage shed and loading area
- iii) Ammonia unloading area and shed.
- jjj) Emergency mud pond for gypsum.
- kkk) Fuel oil storage tanks and daytanks, including dyke wall and pump house
- lll) Miscellaneous tanks including Condensate storage tank
- mmm) Canteen building
- nnn) Yard toilet – 4 nos.
- ooo) Owner's temporary site office of 3500 sqft area with mini conference hall, pantry and toilet facilities including office furnitures.
- ppp) Single storey RCC buildings with brick wall cladding for sub-store, tool room and staff for maintenance shall be provided for each package area like Turbine Generator, Boiler, GIS, FGD, WTP, CHP and AHP, etc.
- qqq) Boundary wall
- rrr) Main entrance gate with security building. The security building includes time keeper office, security cabin, toilets and all other facilities.
- sss) Gate with security cabin at access road from left bank main canal.
- ttt) Office Furniture of latest trends and standard brands shall be provided in all buildings like Service building, Control room building, Canteen, Store buildings, MCC rooms, etc. where O&M staff, Office staff, Operators, etc. required to be posted.
- uuu) Landscaping and green belt development works. The contractor shall appoint senior Architect for prepare the modern layout of Landscaping and greenbelt development.
- vvv) All civil works required for sewage system.
- www) All civil works required for waste water treatment system

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- xxx) All civil and structural works required for fire detection and protection system, including fire water storage tank, fire water pump house and pipe network.
- yyy) Necessary civil works for making lagoons on existing ash ponds (B, C & D) for proposed plant ash disposal.
- zzz) Slope stabilisation, including RCC retaining walls, wherever required.
- aaaa) Supply of grout and grouting below all equipment / structures.
- bbbb) Cable trenches, racks, duct banks, manhole and pipe trenches.
- cccc) All toilet block shall be provided with service water facility and pantries shall be provided with water cooler & RO system.
- dddd) All window of plant & non-plant building shall be aluminum sliding windows.
- eeee) All aluminium Doors/Fiber door and windows sills, jambs and heads shall be provided with Minimum 12 mm thick large granite slab in 1:3 mortar. Such finishes shall be provided in all buildings.
- ffff) Plant roads including access for each building / facilities from main road.
- gggg) Access road from service road of left bank main canal to main plant including bridge / culver for canal.
- hhhh) Surface drains and storm water drainage system of the plant area.
- iiii) Furniture shall be provided in service & technical building and canteen building
- jjjj) Rail over bridge (ROB) for railway crossing. Bridge shall be 15m wide with 1.5m shoulder on both side.
- kkkk) Main road from existing Gate-2 to Proposed power plant area. 7m wide road shall be constructed by GSECL. However, another 7m wide and 1m divider with 1.5m wide shoulder and drains shall be constructed by Bidder for making four lane road.
- llll) Modifications in the existing plant roads are to be carried out with new connecting roads for approach to the various areas in 1x800 MW plant. The approach road from canal service road including canal cross over bridge is in scope of bidder.
- mmmm) Supporting structures and platforms with access for utility pipelines, ventilation ducts and Bus ducts.
- nnnn) Stairs and exits for all buildings meeting TAC norms.
- oooo) All water supply, plumbing and sanitary works including all fixtures for storm water drainage are covered under the scope of the contract.
- pppp) All necessary waterproofing, damp proofing and anticorrosive treatment to buildings, structures and foundations, including underground construction.
- qqqq) The drainage system of proposed area in existing plant shall be developed and connected to existing drainage system including construction, strengthening, extension and modification or new drainage system shall be developed and constructed as per requirements.



- rrrr) Thrust/anchor blocks for pipe lines wherever required.
- ssss) Support foundation, apron and side walls for ash slurry pipeline upto discharge point shall be provided.
- tttt) In RCC main road and internal roads shall be provided 2 numbers of 200mm dia hume pipes with chambers for both the sides at every 200m distance centre to centre shall be provided.
- uuuu) Stone pitching for slope protection work along periphery of filling work shall be Bidder's scope.
- vvvv) All underground concrete surfaces which are contact with soil or ground water shall be applied two coats of bituminous paint.
- wwww) Pipe encasement wherever required, especially at crossings. CW pipes shall be encased throughout along the power house building, up to CW pit.
- xxxx) All necessary civil works for crossing pipes/cables below for roadways and other services.
- yyyy) All temporary facilities, building, offices, porta cabins, labour colonies, staff quarters, roads and services for construction for this package.
- zzzz) Removal of debris, site clearance and micro levelling of the complete site, all-round buildings and premises within the scope of contract prior to completion of work.
- aaaaa) All necessary civil work required for road lighting within the plant area.
- xxvi) Colour code (RAL) for painting of Building interior, exterior and structural steel and shades of colours for sheets shall be submitted to Owner for approval.
- xxvii) It is not the intent to specify herein all the works in the scope of this contract. The scope also includes all other buildings, sheds, equipment foundations, structures and works necessary which are not specifically mentioned here but required for construction, operation and maintenance of the power plant are deemed to be included in the scope of the bidder.

2.17.00 Site Services

- 2.17.01 Safety is to be given utmost priority. Safety is one of the most important philosophy to followed while execution of this project. All precautions shall be taken by the bidder to avoid any unsafe incidents including injury to personnel involved in installation of this project, material damage and environmental damage. Bidder will be completely responsible for any consequential damage arising out of such unsafe acts/incidents by the bidder or bidder's sub-contractor.
- 2.17.02 Fire protection during construction, especially where hot work is being done; till completion is bidder's responsibility.
- 2.17.03 Medical facilities, including facility for bidder's direct and indirect staff and labour involved in the project are bidder's responsibility.
- 2.17.04 Telecommunication facilities as required by the bidder to compete the scope of work including adequate telephone & internet connections and walkie-talkie radios. The bidder shall obtain necessary permission, from the appropriate



authorities to use such radio facilities at site. The bidder shall ensure that the radio communication systems do not cause interference to other radio users and control, instrumentation and communication systems installed in the existing power plant.

- 2.17.05 Bidder shall mobilise adequate number of all machinery required for handling, fabrication, transportation, construction, erection etc, including excavators, graders, compactor, backhoe loaders, cranes, trailers, tipper trucks, tractor trolleys, water tankers etc, of various capacities as required to complete the plant.
- 2.17.06 Bidder shall mobilise all resources required to complete the plant.
- 2.17.07 Bidder shall arrange for conveyance, boarding & lodging and other social facilities etc for all staff and labour involved in installation of this plant.
- 2.17.08 Bidder may arrange canteen/mess facilities as required for his and sub-contractor's staff and labour.
- 2.17.09 Bidder shall arrange adequate temporary and mobile toilets at various locations at site and ensure that all staff and labour use them and ensure the same are strictly used by his and sub-contractor's personnel.
- 2.17.10 Bidder shall ensure sewage collection and disposal from all site facilities during construction period.
- 2.17.11 Bidder shall setup required number of batching plants with adequate capacity to meet the concrete requirements for the package.
- 2.17.12 Site preparation including excavation and removal of all unwanted debris and transportation, disposed-off. If required, the materials for backfilling shall be procured and transportation from borrow area of suitable backfill material, backfilling, compaction, levelling, grading etc..
- 2.17.13 The unwanted debris shall be suitably disposed off by the bidder, subject to owner's approval.
- 2.17.14 Preparation of lay down area and all approach roads from main roads and preparation of internal roads within the battery limits.
- 2.17.15 Construction of storage sheds and fencing for storage area.
- 2.17.16 Storage area including open storage space shall be so developed that all materials can be stored, preserved and retrieved easily and there is no chance of any damage to material, even due to rain or associated slush. All materials in open storage yard shall be stored on sleepers to avoid direct contact with open soil/mud/slush.
- 2.17.17 Boundary/fencing as required for the storage area for security purpose shall be in the scope of bidder. The bidder shall be responsible for any loss of plant item till completion and shall arrange for its timely repair/replacement in case of damage or pilferage.
- 2.17.18 Watch and ward for security and safety of bidder's offices, including that of sub-contractors' and all materials for the plant till completion and handover.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 2.17.19 Erection of temporary structures/sheds as required during the course of execution of project, and relocation of these structures for making construction/erection fronts available for works, as directed by Owner.
- 2.17.20 Construction of bidder's site office and associated office spaces including canteen, parking, air-conditioned stores etc.
- 2.17.21 Distribution of construction power to various locations and installation of additional transformers, underground cables or overhead lines, electric posts, distribution boards etc. Arrangement of electric supply to all points of job. Additional DG sets and portable battery or generator based lighting and power supply arrangements at remote locations where it is difficult to arrange/extend construction power.
- 2.17.22 Distribution of construction and potable water to various locations of the site as required for the package.
- 2.17.23 Bidder shall deploy 1 no. rack & pinion construction lift for boiler.
- 2.17.24 All dewatering as required for construction of the plant.
- 2.17.25 All efforts shall be made to finish all below ground activities before monsoon. However in case of unavoidable circumstances, adequate no. of dewatering pumps shall be mobilised so that progress of work is not affected due to. All precautions shall be taken so that work is not hampered due to heavy rains.
- 2.17.26 The site shall be kept neat and tidy all the time and all construction wastes shall be segregated and disposed properly. Sets of waste drums/bins shall be kept at various locations at the site, and these shall be segregated and marked for different types of waste. All these construction waste shall be cleaned periodically. Disposal from site shall be subject to owner's approval.
- 2.17.27 Bidder shall ensure that all oil and oily wastes are safely collected without any ground contamination and disposed from site without any fire hazard.
- 2.17.28 All scraps shall be segregated, organised and stored at designated places.
- 2.17.29 All packaging material, containers, drums, wooden or other crates, gunny bags and other scraps shall be property of owner, but segregation and storage will be Bidder's responsibility till the site is handed over to owner.
- 2.17.30 The Bidder shall make good damage to roads, drains, foot/path ways, paved areas, boundary walls and fences etc. and clean all fouled roads, paving etc. whether public or existing at site, caused by or in any way attributable to the handling / transport of plant or materials by the Bidder or his sub-Contractors and indemnify the Owner against loss, damage or claims by the Local Authority or others for damage to or fouling of roads, pavings, etc., by reason of unusual traffic or other causes.
- 2.17.31 The Bidder shall at all times ensure that the public roads, giving access to site, are kept clean of any materials deposited by traffic from the Bidder or his sub-Contractors.
- 2.17.32 During construction utmost care shall be taken by the bidder for dust suppression at site i.e. earth work, site/kachha roads, building constructions, site office etc. by cleaning & water sprinkling ..



- 2.17.33 Maintaining proper documentation of all the site activities undertaken by the Bidder as per the proforma mutually agreed with the Owner
- 2.17.34 The site shall be handed over back to the owner in a well organised and neat & tidy condition.
- i) All balance touch-up paintings and final coats shall be completed.
 - ii) All finishing works shall be completed.
 - iii) All roads and drains shall be interconnected smoothly at the terminal points.
 - iv) All drains shall be cleaned and covered before handover.
 - v) All fencing and gates shall be completed.
 - vi) Rain water harvesting shall be completed.
 - vii) All punch list points shall be closed or reconciled between the bidder and Owner.
 - viii) All construction wastes shall be properly disposed off and all scraps shall be sorted, segregated and stored properly as directed by Owner.
 - ix) All temporary works constructed by bidder for establishing the project shall be removed, if directed by Owner.
 - x) All areas shall be cleaned and paint markings shall be provided for demarcations, wherever required and as instructed by the Owner.

3.00.00 BATTERY LIMITS AND EXCLUSIONS

3.01.00 The battery limits or terminal points (TP) and exclusions for the package are as below. In case of any ambiguity, owner's interpretation shall be final.

3.02.00 Battery Limits/Terminal Points**3.02.01 MECHANICAL**

S. No.	Description	Terminal Point	Remarks
1.	Ash Handling Plant	Ash Dyke B, C and D for HCDS slurry line	
2.	Fuel Oil (LDO)	Outlet flange of existing Light Diesel oil (LDO) tank & Discharge of existing unloading pumps.	
3.	Gypsum	Gypsum storage shed	
4.	Raw Water	Existing canal & CWP of Unit no. 1&2	

Note: Wherever applicable, terminal points shall start/end with counter flange, fixing bolts and nuts, gaskets etc.



3.02.02 ELECTRICAL

- i) Extension of existing 400KV AIS switchyard buses for the proposed 2 bays of 400KV AIS.
- ii) Interconnection of proposed earth mats at minimum 3 locations/points of the existing plant earth grid.

3.02.03 CIVIL

- i) Nil

3.02.04 CONTROL AND INSTRUMENTATION

- i) Nil

3.03.00 Exclusions

3.03.01 Mechanical

- i) Railway siding and marshalling yard
- ii) Fuel oil (LDO) unloading facility
- iii) Ash Dyke B, C and D

3.03.02 ELECTRICAL

- i) Nil

3.03.03 CONTROL AND INSTRUMENTATION

- i) Nil

3.03.04 CIVIL

- i) Workshop building
- ii) Administrative building

4.00.00 BASIC PLANT TECHNICAL AND DESIGN REQUIREMENTS

4.01.00 All items for the plant shall be brand new and any refurbished or used item should not be used for any of the equipment or systems of the project.

4.02.00 Components of same function and similar duties shall be of same make and interchangeable as far as possible.

4.03.00 Components shall be standardised as far as possible to reduce spares inventory.

4.04.00 All items, equipment and systems of the package shall be designed for a life span of minimum 40 years. All civil structures shall be designed for a life span of minimum 50 years. The plant shall be designed for a trouble free operation over entire life of the plant.

4.05.00 The design of all equipments shall conform to the best and current engineering practice. It shall ensure reliability, simplicity and provide long continuous service with high economy and low maintenance.

4.06.00 Material of construction (MOC) all parts/components/assemblies of equipment shall be so selected that its physical and chemical properties are optimum for the intended service.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 4.07.00 All components of the plant shall be suitable for full range of ambient and other environmental conditions prevailing at the site.
- 4.08.00 All items, equipment and systems of the package shall be designed to ensure high level of reliability & availability.
- 4.09.00 The plant shall be designed such that efficiency of individual equipment and the system as a whole should be optimum.
- 4.10.00 Safety is to be given at most importance in design of equipment and whole system. The plant has to be designed to avoid any injury to plant personnel, loss of equipment/material, loss of generation/operation or damage to the environment due to design fault.
- 4.11.00 Ease of maintenance and operation of each and every item of the plant shall be equally important design philosophy for the plant.
- 4.12.00 Suitable handling arrangement and approach shall be provided for all items of the plant. Electric hoist or crane shall be provided for handling all items above 1 ton.
- 4.13.00 The metric system of Weights and Measures shall be exclusively used in this project.
- 4.14.00 KKS tagging philosophy shall be followed uniformly for all mechanical, electrical and instrumentation equipment, components, systems.
- 4.15.00 All software packages to be used for design of the plant shall proven and have proper validation report.
- 4.16.00 Although detailed technical requirements are mentioned in other respective sections of the specification, they are deemed to be applicable to all similar equipment/systems.
- 4.17.00 The plant shall comply with all applicable statutory stipulations of Ministry of Environment and Forest & Climate Change (MoEFCC), Central Pollution Control Board (CPCB), State Pollution Control Board (SPCB) and other statutory authorities.
- 4.18.00 The oil system and its facilities will be designed as per Petroleum Rules/Explosion Acts/Fire Rules of Govt. of India.
- 4.19.00 Design of the plant shall be such that all components and equipment are suitable to withstand occurrences of periodic abnormal operating conditions.
- 4.20.00 The complete plant shall be designed with adequate redundancy. As a rule 100% redundancy shall be followed for all critical/important equipment unless specified otherwise.
- 4.21.00 All stand-by auxiliaries shall be designed for auto start up, on failure of running auxiliaries with minimum time delay and without runback on unit load.
- 4.22.00 All auxiliary equipment and drive motors shall be capable of delivering satisfactorily their rated outputs continuously for a voltage variation and frequency as mentioned elsewhere in the specification.
- 4.23.00 Pressure wherever mentioned in the specification is gauge pressure unless specifically mentioned as absolute pressure.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
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SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 4.24.00 Design pressure shall be 1.5 times maximum working pressure for all items unless specified otherwise.
- 4.25.00 For all low-pressure piping & accessories, ASME 150# class and for high pressure piping & accessories ASME 300-900# class will be applicable
- 4.26.00 All process tanks should be provided with high and low level controls and alarms.
- 4.27.00 A minimum of 300mm free board shall be provided for all tanks in general. For bigger tanks, higher freeboard may be provided.
- 4.28.00 Advantage of gravity shall be utilised for flow wherever possible.
- 4.29.00 All equipment shall be installed above ground. Below ground installation will not be allowed, but if a below ground installation is unavoidable, then proper maintenance space and dewatering arrangement has to be provided. Collection of oil and dirt in that area has to be avoided and it should be easy to clean such a place.
- 4.30.00 The design power output at 100% TMCR condition shall not be less than 800MW and VWO capacity shall be 840MW.
- 4.31.00 Plant, especially the structures shall be designed taking into consideration the good aesthetics.
- 4.32.00 Basic technical requirements of various systems are mentioned herein.
- 4.33.00 The owner will interpret the meaning of drawings and specifications and shall be entitled to reject any material or work, which according to him is not in accordance with what, is specified or required.
- 4.33.01 All civil structures shall be designed for a life span of minimum 50 years.
- 4.33.02 All buildings in the project shall be in RCC construction with brick walls if not mentioned specifically elsewhere in the specification.
- 4.33.03 Pump shall be designed as below otherwise elsewhere specified
- i) Horizontal and Vertical Pump
- The maximum efficiency of pumps shall be preferably within +10% of the rated design flow.
 - The head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off without any zone of instability and with a minimum shut-off head of 15% more than design head.
 - Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division.
 - The head vs capacity and BHP vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical shall be interchangeable.
 - Pumps shall run smoothly over the entire range of NPSH conditions without undue cavitation, noise & vibration. Peak to peak vibration limits shall be restricted to the following values during operation.



Speed	Antifriction bearing	Sleeve Bearing
1500 rpm & below	75.0 microns	75.0 microns
3000 rpm	50.0 microns	65.0 microns

- f) The noise level shall not exceed 85dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1m from the equipment surface.
- g) The pumps shall be capable of starting with discharge valves open & close condition.
- h) Selection of pumps shall be such that the design point shall be met even with negative manufacturing tolerance.
- i) The pump shall be of stiff shaft design. The maximum internal clearances should be sufficiently more than the maximum static deflection of the shaft. Shaft size selected must take into consideration the critical speed as specified in API-610.
- j) Following codes shall be referred to:
- 1) IS 1520
 - 2) IS 5120
 - 3) API 610
 - 4) IS 5639
 - 5) IS 5659
 - 6) HIS
 - 7) IS 1710
 - 8) And as specified.

ii) *Horizontal Pumps*

- a) Pump casing shall have radially/axially split type construction. The casing shall be designed to withstand maximum shut-off pressure developed by the pump at the pumping temperature.
- b) The pumps may be single or multistage.
- c) Pump casing shall be provided with a vent connection and piping with fittings & valves, casing drain as required shall be provided complete with drain valves, piping & plugs. It shall be provided with a connection for suction & discharge pressure gauge as standard feature.
- d) Impeller – Impeller shall be closed or semi-closed as specified and designed in conformance with the detailed analysis of the liquid being handled.
- e) Impeller/casing wear rings – Replaceable type wear rings shall be provided at suitable locations with suitable method of locking.
- f) Shaft – The critical speed of shaft shall be well away from the operating speed and in no case less than 130% of the rated speed.



- g) Shaft sleeves – Shaft sleeves shall be fastened to the shaft to prevent any leakage or loosening and shaft sleeve assembly should ensure concentric rotation.
- h) Bearings
- 1) Heavy duty bearings, adequately designed for the type of service specified and for long trouble free operation.
 - 2) The bearings offered shall be capable of taking both radial and axial thrust coming into play during operation. In case, sleeve bearing are offered, additional thrust bearings shall be provided
 - 3) Bearing life shall be minimum 40,000 hrs (L-10) of continuous operation at rated load and speed.
 - 4) Proper lubricating arrangement for the bearings shall be provided such that lubricating element does not contaminate the fluid pumped. Where there is possibility of liquid entering the bearings, suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearing assembly.
 - 5) Bearings shall be easily accessible without distributing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing.
- i) Stuffing Boxes – Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standard. If external gland sealing is required, it shall be done from the pump connection. Gland packing shall be non-asbestos type.
- j) Mechanical seals – Wherever specified in pump data sheet, mechanical seals shall be provided. The sealing face shall be highly lapped surfaces of material known for their low frictional co-efficient and resistance to corrosion against the liquid being pumped.
- k) Pump shaft-motor shaft coupling – The pump and motor shaft shall be connected with a adequately sized flexible coupling of proved design with a spacer to facilitate dismantling of the pump without disturbing the motor.
- l) Base plate
- 1) A common base plate mounting, both for the pump and motor shall be furnished. The base plate shall be of fabricated steel and of rigid construction, suitably ribbed and reinforced.
 - 2) Assembly and dismantling of each pump with drive motor shall be possible without dismantling the grouting base plate or alignment.
- iii) *Vertical Pumps (Turbine type, mixed/axial flow)*
- a) Pumps shall be of vertical shaft, complete with bowl, column pipe, discharge head and base plate with all accessories, as applicable.
 - b) Bowl assembly



- 1) Shall be either single stage or multi stage vertical turbine type, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of the handling fluid.
 - 2) Pumps shall have provision for adjustment of impellers in vertical direction from an accessible location, preferably at the housing (where separate thrust bearing for the pump is provided). The adjustment mechanism must take into consideration the extension of line shaft due to hydraulic down thrust, weight of the shaft and impeller.
- c) Discharge head
- 1) Pumps shall have either above floor or below floor discharge type, as specified.
 - 2) In case expansion joint has to be used at the pump discharge, pump base plate shall either be adequately designed to take the unbalanced forces and moments from the use of such expansion joint, or a separate thrust block at the pump discharge head shall be provided to transmit these forces to the external supporting structure. Calculation of thrust load shall be done considering the highest pressure expected by the pump and internal diameter of the arch of the expansion bellow.
- d) Column pipe
- 1) Column pipe shall be flanged and of bolted connection. Column pipes shall be designed for full internal vacuum.
 - 2) In case of multi-piece column pipe and shaft assembly, the design shall permit raising/lowering of the pump assembly piece by piece without any difficulty. Fixtures, clamps and other tools and tackles, required for the same shall be part of the pump supply.
- e) Impeller shaft, line shaft & head shaft
- 1) Shaft size shall be selected based on the maximum torque to be handled by the pump shaft.
 - 2) Critical speed of the shaft shall be sufficiently away for the pump operating speed and in no case shall lie between 90% and 110% of the rated speed.
 - 3) Impeller shaft shall be guided by bearings provided in each bowl or above or below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall be chamfered at the edges.
 - 4) Line shaft may be of single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the manufacturer's standard practice.
 - 5) For screwed coupling, screw directions shall permit tightening of the joint during pump operation.



- 6) Replaceable shaft sleeves shall be furnished at applicable locations, particularly under stuffing box and at other locations, as considered necessary.
- f) Shaft enclosing tube – Shaft enclosing tube shall be required, unless self-lubricating (and cooled) type of shaft bearings are asked for. Length of the shaft enclosing tube shall be in conformity with the shaft piece lengths.
- g) Seal rings – Replaceable seal/wear rings both on impeller and on casing shall be provided, if asked for.
- h) Shaft Bearings
- 1) Adequate numbers of properly selected/designed bearings shall be provided for smooth operation of the pump. Number of bearings shall be considered based on the number of shaft pieces used and critical speed of the shaft.
 - 2) Bearings may be either lubricated by external clear water/oil/grease or self-lubricated as specified.
 - 3) Complete lubrication arrangement shall be furnished with the pump. If pre-lubrication is required, then the associated pre-lubrication tanks and accessories shall be provided with the pump.
- i) Thrust bearing
- 1) Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and the dead load of the rotating components.
 - 2) Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load.
 - 3) Thrust bearings shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handling fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of tripping.
 - 4) Pre-lubrication system if required, shall be provided.
 - 5) Cooling of the thrust bearing, if necessary, shall be done by the handling fluid/external water, depending on the fluid handled.
 - 6) Location of the thrust bearing may be at the pump body or at the driver, or at both, depending on the requirement.
- j) Reverse rotation – If specified, the pump impeller and other rotating components shall be designed for reverse rotation, when subjected to reverse flow at rated pump discharge head.
- k) Other requirements may be similar to those of horizontal pumps.
- iv) *Drive motor*
- a) The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified.



- b) In case of parallel operation of the pumps is specified, the actual motor rating is to be selected considering overloading of the pump in the event of tripping of operating pump.
- c) Continuous motor rating (at 50°C ambient temperature) for the pump shall be at least 10% above the maximum load demand of the pump in the complete range or 15% over the duty point, whichever is higher.
- v) *Submersible pumps*
- a) Pumps shall be submersible wet type, as per IS 8034 & IS 5120, or as specified.
- b) The pump shall be of single stage mono-block type with non-clog design.
- c) Pumps shall be portable type and capable of using in any sump as and when required.
- d) Pumps shall be provided with required stool and flexible hose chain connection, for easy installation and removal. Length of chain and flexible discharge pipes shall be suitable for lowering the pump into the deepest sumps.
- e) Pumps shall be able to handle solids up to 100mm and capable of handling waste water which may contain sludge, plastic, solids etc.
- f) Coupling device shall ensure leak proof joint between the pump and discharge elbow. This shall also enable the pump to be removed from the sumps without the necessity of dismantling any fasteners.
- g) In case of open impeller, the pump shall be designed to take care of the additional thrust produced.
- 4.33.04 Tank shall be designed as per below otherwise elsewhere specified
- i) Tanks shall be suitable constructed for continuous safe storage of liquid intended.
- ii) The connections, accessories and fittings to be furnished with each tank shall be as specified and as required. All nozzles and piping material required both inside and outside, up to the flanged terminal shall be furnished with the tank.
- iii) All tank connections shall be provided with suitable counter-flanges with necessary gaskets and fasteners.
- iv) Flange faces of all nozzles shall be machined and square with the vessel centrelines.
- v) Reinforcement pads in tank connections shall be provided as applicable and reinforced connection shall be completely preassembled into a shell plate. The complete assembly including the connection shall be thermally stress-relieved as per API 620.
- vi) The tank shall be complete with supporting structure, legs, pedestals, base plate, anchor bolts, nuts, sleeves etc., as applicable and required.
- vii) Special fittings like vents, drains, flame arrestors, breathers etc, as applicable & as required shall be furnished with the tank.



- viii) Design of tank, including, preparation of detailed design, fabrication drawings, bill of material, tag, piece numbers, welding procedure, etc. Stiffeners and other structural framing for supporting the tank shall be part of the tank design.
- ix) Except where specified, if stiffening of the shell and/or roof is required, it shall be stiffened from outside.
- x) All welding shall be done as per IS 816, 817, 822& 9595, as applicable. Welding sequence shall be so adopted to minimise distortion due to welding shrinkage.
- xi) Welding sequence shall be indicated in the drawings and shall be approved by the engineer.
- xii) The designer and manufacturer of the storage tanks shall comply with and obtain approval of applicable statutory regulations and safety codes.
- xiii) Due consideration for wind load and/or earthquake effect shall be given by the Bidder in the design of tanks. Maximum allowable stresses for design loadings combined with wind and/or earthquake shall not exceed 133% of stress permitted for the design loading condition, but in case shall exceed 80% of specified yield strength
- xiv) The material, minimum thickness, size and other details shall be as per system requirement and codes.
- xv) Following codes shall be referred to:
 - a) IS 803
 - b) IS 804
 - c) IS 805
 - d) IS 816
 - e) IS 9595
 - f) BS EN 12285 – 1 & 2
 - g) IS 10987
 - h) API 650
- xvi) Design of all vertical atmospheric tanks to store water, LDO, acid, alkali and other chemicals shall confirm to IS 803 & API 650.
- xvii) Design of all horizontal atmospheric storage tanks to store water, acid, alkali and other chemicals shall confirm to IS 2825 as regards to fabrication and general construction taking care of combined bending, shear & hoop stresses developed due to supporting arrangement.
- xviii) Design temperature of vessels shall be 10°C higher than the maximum temperature that any part of the vessel is likely to attain during the course of operation.
- xix) Tank shall be made from mild steel plates to IS 2062 Gr. B (or equivalent).
- xx) The joint efficiency factors shall be as specified in design codes.
- xxi) Tanks shall be provided with suitable supporting joints. All vessels shall be provided with lifting lugs, eye bolts etc, for effective handling during erection.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- xxii) The material for flanges shall be ASTM A 105 / IS 2062 Gr. B, as specified for the application.
- xxiii) For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several passes for true curvature.
- xxiv) Vessels shall be so positioned that they do not pass through vessel connections. For cylindrical vessel consisting of two sections longitudinal seams shall be offset.
- xxv) Where possible, the inside seam weld shall be ground smooth, suitable for application of corrosion resistant primer.
- xxvi) Tanks shall be provided with float operated level indicators / level gauges / level switches and level transmitters as specified, with complete assembly. Suitable flanged pads for level switches mounting shall also be provided. Level indicator may be top or side mounted. For smaller tanks, reflex type gauge glass shall be provided.
- xxvii) SMART (HART) type DP level transmitters shall be provided for continuous level measurement as well as for alarm/interlock, as per system requirement.
- xxviii) In addition to inlet and outlet nozzles, the tank shall be provided with vents overflow, drain nozzles complete for various connections on tanks. Overflow lines from tanks to be routed to the nearest surface drains.
- xxix) Manhole size shall be minimum 600mm.
- xxx) For tanks containing DM water, alkaline water or power cycle water, the vent to atmosphere shall be through a carbon dioxide absorber, suitable mounted on the vessel. CO₂ absorber vessels shall be provided with initial fill of chemicals.
- xxxi) Similarly for equipment cooling water overhead tank, the overflow & drain from tank shall be combined together and shall be led to nearest drain (at ground level) via a seal-trough so as not to come directly in contact with atmosphere.
- xxxii) Tanks shall have suitable stairs/ladders, platforms/walkways, railings, manholes etc as required and suitable located. Ladder with cage shall be provided when tank height exceeds 2m.
- xxxiii) BS EN 12285-1 & 2 shall be followed in general for installation of tanks.
- xxxiv) The finished tank grade for cylindrical tank shall be crowned from the outer periphery to the centre with a slope. The sloping factor shall be taken as 1:35 unless specified.
- xxxv) Coal tar shall be filled between tank bottom and foundation gap for all tanks.
- xxxvi) Tank design and fabrication drawings shall be approved by the engineer.
- xxxvii) Corrosion protection
- A corrosion allowance, applicable to surface in contact with corrosive media, when required, shall be taken into consideration.
 - Each tanks shall be provided with drilled cleats welded to the tank for electrical grounding. Material of cleats shall be same as that of the shell.



- c) Inside surface of all tanks shall be protected by anti-corrosive paints as required.
- d) Tanks shall be blast cleaned using non-siliceous abrasive material after usual wire brushing.
- e) Epoxy coating shall be provided on the outside and inside of vessel with one primer coat and two coats finish coats, resulting in total thickness of not less than 150 DFT.

4.34.00 Electrical Systems

5.00.00 CODES AND STANDARDS

5.01.00 All equipment, systems and works covered under these specifications shall be in accordance with all the latest applicable statutes, regulations, codes and standard specified as well as all such standards, statutes, regulations and safety codes applicable in the locality where the equipment will be installed. Bidders may familiarize themselves with all such requirements before preparation of bids. Complete design including pressure parts, piping, valves and fittings shall meet or exceed all the requirements of the latest versions of Indian Boiler Regulations (IBR), Indian Standards / ASME codes.

5.02.00 The design, construction and testing of all equipment, facilities, components and systems shall be in accordance with latest version of relevant standards and codes issued by Bureau of Indian Standards (BIS) and/or reputed international standards and codes. A non- exhaustive list of reputed international standards is given below:

American National Standards Institute (ANSI)
 American Petroleum Institute (API)
 American Society of Mechanical Engineers (ASME)
 American Society of Testing and Materials (ASTM)
 American Water Works Association (AWWA)
 American Welding Society (AWS)
 British Standards (BS)
 Cooling Technology Institute (CTI)
 Deutsches Institute for Normung (DIN), Germany
 Gosstandart of Russia (GOST) standards
 Heat Exchange Institute (HEI), USA
 Hydraulic Institute Standards (HIS), USA
 International Electro-technical Commission (IEC)
 Institute of Electrical and Electronics Engineers (IEEE)
 International Organisation for Standardisation (ISO)
 Japanese Industrial Standards (JIS)
 National Electric Code (NEC), USA



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

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AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

National Electrical Manufacturers Association (NEMA), USA

National Fire Protection Association (NFPA), USA

Occupational Safety & Health Administration (OSHA)

Tubular Exchanger Manufacturers Association (TEMA), USA

VDE association for Electrical, Electronic and Information Technologies (VDE), Germany

- 5.03.00 Other international Standards, equivalent or superior to the above Standards can also be adopted. However, in the event of any conflict between the requirements of the international standards or codes and the requirements of the BIS standards or codes, the latter shall prevail. In the event of any conflict between the requirements of equivalent codes and standards, and the requirements of IBR, the latter shall govern unless specified elsewhere in the specifications. In other cases the more stringent of the two shall prevail.
- 5.04.00 The plants and associated systems shall also be designed to comply with the requirements stipulated in:-
- 5.04.01 Central Electricity Authority (Construction of Electrical Plants & Electric Lines) Notification of 20th August 2010
- 5.04.02 Central Electricity Authority (Installation and Operation of Meters) Regulations.
- 5.04.03 Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations
- 5.04.04 Central Electricity Authority (Measures relating to Safety and Electricity Supply), Regulations as and when these are notified by the Authority.
- 5.04.05 Central Electricity Authority (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electric Lines) Regulations as and when these are notified by the Authority.
- 5.04.06 Central Electricity Authority (Grid Standards) Regulations as and when these are notified by the Authority.
- 5.04.07 Central Electricity Authority (Technical standards for Construction of Electrical Power Plants and Electric Lines) Regulations 2010
- 5.04.08 Indian Boiler Act, 1923, and Rules and Regulations specified thereunder.
- 5.04.09 Indian Electricity Act, 2003 and Rules and Regulations specified thereunder.
- 5.04.10 Indian Explosive Act and Rules and Regulations made thereunder
- 5.04.11 Indian Factory Act and Rules and Regulations made thereunder
- 5.04.12 Indian Petroleum Act and Rules and Regulations made thereunder
- 5.04.13 Indian Electricity Grid Code issued by Central Electricity Regulatory Commission (CERC) and
- 5.04.14 Applicable State Grid Code issued by appropriate Regulatory Commission
- 5.04.15 National Building Code (NBC)
- 5.04.16 Tariff Advisory Committee (TAC)



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
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SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 5.04.17 Chief inspectorate of factories in Gujarat
- 5.04.18 Chief electrical inspectorate in Gujarat
- 5.04.19 Gujarat state pollution control board
- 5.04.20 Any other codes/standard published by Government of India / other agencies and institution have a bearing over the performance of the contract.
- 5.05.00 In all instances, the finally accepted applicable code or standard shall be the version last published.
- 5.06.00 All material and equipment supplied and all work carried out as well as calculation sheets, drawings, quality and class of equipment, methods of inspection, constructional peculiarities of equipment and parts and acceptances of partial plants, as far as these are beyond the special requirements of the specifications, shall comply in every respect with the technical codes of the above listed codes and Standards
- 5.07.00 The design of Steam Generator shall meet or exceed all the requirements of latest editions of Indian Boiler Regulations (IBR). Any other standard acceptable to IBR can also be considered, provided that the requirements of that standard are equivalent or more stringent than the IBR requirements.
- 5.08.00 The turbine generator shall comply with general requirements and standards of latest versions of IEC-45 and 46, IEEE-122, IEC-34-1, IEC-34-3 or their approved equivalents
- 5.09.00 It shall be the responsibility of the Bidder to take all approvals required and get the boiler registered under the IBR. In all other cases where IBR does not govern, IS/ASME, Japanese, American, British, German or other international standards established to be equivalent or superior to IS/ASME shall be acceptable with the approval of the owner and owner's consultant at the time of detailed engineering..
- 5.10.00 Where there are no standards or regulations, or the standard is not sufficient to meet the need of design and supply, for such items relating to the power project, the Bidder shall carry out the design, manufacture, supply and installation on the basis of good engineering practice with Owner's and owner's consultant's approval.
- 5.11.00 During the period of Contract execution, if any standards change, the Bidder shall be responsible to notify the owner and provide the basis for the prospect that it would not cause the lowering of quality, performance and service life of the power plant due to alteration of the standard. Upon mutual agreement, the amended standard can then be followed.
- 5.12.00 Bidder shall furnish English translations of standards, if specifically requested to which the equipment and systems offered are conforming to.
- 5.13.00 Further requirements about applicable standards and codes are specified in the detailed technical specifications.



6.00.00 PLANT OPERATING CAPABILITY AND UNIT OPERATION PHILOSOPHY

6.01.00 Operating Capability of the plant

6.01.01 The plant, its unit and its all auxiliaries equipment/systems shall be designed to operate with all the specified margins for continuous operation without any limitations under any of the conditions indicated in the Technical Specification.

6.01.02 The major operating capabilities for the unit/plant shall be as follows:

- i) Operate continuously with turbine under VWO condition with rated steam parameters, design condenser pressure and 1% cycle make up.
- ii) Sliding Pressure Operation from rated pressure down to 40% of rated pressure with as well as without any throttle reserve. For modified sliding pressure condition, at any operating load, the throttle reserve shall be sufficient so as to achieve an instantaneous increase in turbine output by 5% of the corresponding load, by opening turbine control valves wide open. However, the output after instantaneous increase shall be limited to 105% of TMCR Load. The throttle reserve shall be 0% for pure sliding pressure mode of operation.
- iii) Operate continuously with HP heaters out of service with maximum specified cooling water temperature, 1% cycle make up and normal auxiliary steam requirement being tapped from cold reheat line, to generate maximum output without over stressing turbine components. The power output of the unit under this operating condition shall not be less than 800 MW or output corresponding to design BMCR heat duty, whichever is lower.
- iv) Automatic run back capability of the unit load on loss of critical auxiliary equipments, ensuring smooth and stable runback of the Steam Generator and Steam Turbine Generator equipments and systems.
- v) Continuous TG output of 800 MW under rated steam conditions, specified worst condenser pressure, 1% cycle make-up and 47.5 Hz grid frequency.
- vi) The equipments and auxiliaries shall be suitable for continuous operation in the frequency range of 47.5 Hz to 51.5 Hz.
- vii) Unit shall be able to start up with TDBFP in case of non-availability of MDBFP and proper logics and Control loops shall be designed accordingly
- viii) Unit shall be capable of increasing the load through condensate flow regulation in order to meet the load cycling requirement. Necessary measurements and logics shall be provided for implementation of the same. During condensate flow regulation hotwell level may be maintained through excess condensate dump line to condensate storage tank.
- ix) Unit shall be capable of meeting all requirements of CEA for flexible operation without and major degradation to the life of consonants.
- x) Unit shall be able to run without BRP and same shall be demonstrated by Bidder for Cold, Warm and HOT start, also SOP shall be submitted in advance for the review.
- xi) Turbine shall be capable of operation on variable pressure mode during part load & start-up operation.



- xii) TG set shall be capable of operating on house load during sudden total export load throw off using HP-LP bypass system. Unit shall not trip on over-speed in the event of total export load throw-off. TG output for house load operation may be considered 50 MW at least for 1 hour.
- xiii) In case of sudden reduction in demand (load throw off), the unit should get safely unloaded and stabilized for operation at house load with HP-LP bypass open to full capacity. All the components including valve body of HP and LP Bypass valves shall be designed for boiler highest safety valve set pressure due to sudden load throw offender transient conditions.
- xiv) HP-LP Bypass should be capable of operation in parallel with turbine with all feed water heaters in service.
- xv) Bidder shall furnish Pure sliding pressure & Modified sliding pressure operation curves.
- xvi) Plant shall be designed to give life of not less than 25 years. Further, expected numbers of Steam Turbine Generator start ups during design life are as follows:

Type of Start	Number of Starts
Hot Start	4500
Warm Start	1300
Cold Start	500

- 6.01.03 All the systems/equipments/auxiliaries under Bidder's scope shall be designed to cater to the above operating conditions envisaged for the unit/plant by the Owner. Unless specified otherwise in the Technical Specification the design should cater to the above operating conditions with adequate margin as per standard practice prevailing in the fossil fired power plants.
- 6.01.04 The plant shall be suitable for load cycling which implies that it should be designed to operate continuously under two shift mode (daily start stop with one shift off) and load follow mode as specified. The design would cover adequate provision for quick start-up and loading of the unit to full load at a fast rate. The unit shall have minimum rate of loading or unloading of 3% per minute above the control load (i.e. 50% MCR). Plant shall be capable of minimum N1 number of daily load cycles (N1 shall not be less than 2), load variation from 100% to 50 % (and vice versa) of MCR with a minimum ramp rate of 3% per minute without affecting the design life of boiler and turbine-Generator systems. In addition, the plant shall also be capable of minimum N2 number of daily load cycles (N2 shall not be less than 1) from 50% to boiler minimum once through load (and vice versa) with a minimum ramp rate of 1% per minute without affecting the design life of boiler and turbine-Generator systems.
- 6.01.05 The design of the plant equipments and control system would permit participation of the plant in automatic load frequency control.
- 6.01.06 Bidder shall design Turbine-Generator system meeting the load cycling conditions as indicated above. In no case the design life of Turbine-Generator system shall be affected due to -



- i) 'Fatigue Damage', resulting from
 - a) The number of Cold start up, Warm start up and Hot start up as defined elsewhere in the specification and
 - b) Load cycling during defined plant life.
 - ii) 'Creep damage'
 - iii) The combined creep fatigue damage shall lie within acceptable limits.
- 6.01.07 For the steam generator, in addition to the above requirement, specific design features incorporated and design/process improvements which are being offered for N1/N2 cycles shall be submitted along with the bid. Such design features and design/process improvements over and above conventional design shall be clearly brought out by the bidder in its bid. The Bidder shall provide references for earlier supplied steam generators which meet the specified cyclic duty requirements.
- 6.01.08 The analysis and design/process improvements for cyclic operation suitability shall include all critical boiler components like headers (final Super heater outlet, economizer outlet, final reheater outlet etc.), membrane wall construction elements (tubing attachments, tension bars etc.), wind-box elements, boiler recirculation pump casing, superheater/reheater attachments, dissimilar weld joints etc.
- 6.01.09 The Bidder shall provide information to the process adopted and analysis carried out for the design and operational improvements. Following shall be necessarily included:
- i) Header thickness reduction: the intervention may include improvement in properties of materials or materials, increase in number of headers etc.
 - ii) Use of full penetration welds for header/stub welds and header ligament design improvements
 - iii) Design improvement in the mechanical design of water walls
 - iv) Design improvements to prevent economizer steaming
 - v) Stress concentration improvements: identification of critical zones, fatigue analysis, operational feedback of regular de-signs; analysis/redesign of water-walls tube/fin system, SH/RH attachments, BRP (boiler recirculation pumps) casing design etc.
 - vi) Water chemistry improvements
 - vii) Vent/drain/spray system sizing improvements
 - viii) Expansion joints design improvements and fatigue tests
 - ix) Refractory improvements
- 6.01.10 Analysis of designs shall include CFD and FEM investigations. The bid proposal may be developed by the bidder based on earlier studies/investigations. CFD studies and FEM investigation shall be specifically carried out for the equipment/component selected/designed for the subject project/package. Necessary reports for the analysis (CFD and FEM) shall be furnished to the



employer. The performance data required for the analysis shall be developed using dynamic modelling for the steam generator.

- 6.01.11 Visual/NDE protocols additionalities for critical components/equipment, analysis of fatigue damage and load cycling consideration as per the BS-EN 12952-3 or other equivalent code or other equivalent code etc.
- 6.01.12 Results of design analysis which are required to be submitted as part of the EIFS (Engineering information flow system) shall be tied up with the Contractor. The Contractor shall be required to establish the design additionalities (changes in design, dimensions etc.) for making the steam generator suitable for load cycling as part of the bid proposal. The same shall be submitted as a separate document which shall be identified under EIFS. The document shall comprehensively cover each of the above-mentioned areas/components and others identified by the bidder. The process of analysis and results shall include in the document along with conceptual designs. The Contractor shall be required to help employer's engineer run through the complete analysis (as many areas shall not form part of the submitted document).
- 6.01.13 Periodic inspection shall be carried out by the Contractor during the warranty period of all pre-identified areas with stress concentration. The specifications include thermo-couples and other instruments to collect necessary data for the field test which shall be collected to enable further confirmation of the offered design and/or trouble-shooting. Bidder shall recommend additional instrumentation that may be required for the purpose.
- i) Provision for life consumption/Equivalent Operating Hours (EOH) of critical components due to Creep & Fatigue shall be made available online (display in CCR) for operating personnel. Also program/measures shall be made available online (display in CCR) to guide the operating personnel for maintenance planning.
 - ii) Resulting Damage Factor due to Creep-Fatigue interaction shall be made available online (display in CCR) for Operating personnel.

6.02.00 Unit Control Philosophy

6.02.01 BOILER WET- DRY STATE CHANGEOVER

- i) At around 30% TMCR load, water separator level eventually disappears. The boiler now operates in once through mode and boiler recirculation pump will shut down at approx. 35%TMCR load.

6.02.02 HP-LP BYPASS CONTROL PHILOSOPHY

- i) *HP Bypass*
 - a) HP bypass control valves are opened to minimum position of 15% (To be adjusted during commissioning) with fire on in order to establish the flow through boiler.
 - b) Maintain the HP bypass at minimum position until MS Pressure attains around 10 Kg/cm² (To be adjusted by bidder) value. Once this pressure value achieved HP Bypass valve shall open to certain predetermined value at same pressure and thereafter pressure shall be built up at same valve position till rolling pressure is achieved.



- c) The rate of pressure rise shall be determined by OEM with respect to various start ups.
- d) Then HP bypass will be put in fixed pressure mode at rolling pressure.
- e) Further when required temperature parameter is achieved by increasing the firing rate, HP Turbine valve starts to open and steam is admitted to the turbine.
- f) The bypass valve continues to maintain the fixed pressure till synchronisation.
- g) As the turbine starts accepting steam, bypass will start to close until turbine consumes all the steam.
- h) Once the HPBP valve is closed fully, the pressure set point shall track the actual pressure plus a threshold "dp" as per standard practise of OEM.
- i) Spray to HPBP shall be operated to control the downstream enthalpy.

ii) *LP Bypass*

- a) LP bypass are opened after establishing sufficient condenser vacuum and water supply for de-superheating.
- b) LP bypass valve are closed until a minimum pressure of 2 kg/cm² (To be determined by OEM) is measured on HRH and the controller begins to control the HRH steam pressure by operating LPBP valves.
- c) The LPBP valve is allowed to open to some predetermined value while maintaining the HRH pressure of 2 kg/cm² (To be determined by OEM). Thereafter the set point for LPBP starts to increase with gradient determined by OEM for different modes of start-ups.
- d) The rolling pressure & temperature is built up in HRH at predetermined position of LPBP valve after which the rolling pressure is maintained during rolling of turbine by LPBP valve operation.
- e) As the turbine starts accepting steam, bypass will start to close until turbine consumes all the steam.
- f) Once the LPBP valve is closed fully, the pressure set point shall track the actual pressure plus a threshold "dp" as per standard practise of OEM.
- g) Spray to LPBP shall be operated to control the downstream enthalpy.

6.02.03 AUXILIARY BOILER

- i) Auxiliary steam from Auxiliary boiler will be the dedicated source established in the plant for the auxiliary steam system.
- ii) Auxiliary steam system during the start-up of boiler in the plant will be supplied from the auxiliary boiler. The outlet of auxiliary boiler shall be connected to station header.
- iii) Isolation valve is to be provided in the auxiliary boiler outlet to isolate the auxiliary steam source from system.
- iv) A check valve has to be provided to prevent the back flow of auxiliary steam to the auxiliary boiler.

**6.02.04 AUXILIARY STEAM SYSTEM OPERATION**

- i) During Start-Up operation auxiliary steam will be supplied from auxiliary boiler. The auxiliary steam supply from this source will be in service up to around 30% TMCR load.
- ii) With the increase of main-steam parameters steam will also be supplied from main-steam line through high capacity PRDS at approx. 10% Boiler Load. With the increase of load, parameters of CRH will increase and the auxiliary steam source will be shifted from main-steam to CRH at approx. 30% Load. When this line is operated, the steam pressure is maintained by throttling, but the temperature will vary between 280°C to 320°C.
- iii) If the low capacity PRDS is unable to maintain the header pressure, the high capacity PRDS will come in service to meet the requirements of auxiliary steam.

6.02.05 HOTWELL LEVEL

- i) Normal level in Condenser is maintained by adding make-up water through normal makeup control valve (upto 3% makeup).
- ii) If the make-up demand is not met through normal make-up and level falls below pre-determined level (adjustable), emergency makeup shall be supplied through Emergency makeup valve.
- iii) In case the level rises above predetermined high level, the high level controller shall become operative at the high level and maintain the level by opening control valve on the excess condensate dump line. Alarm shall be provided in control room for hot well level high and low.
- iv) Motorised regulating valves are provided in bypass lines to control valves of Normal/Emergency make-up line which can be put into operation remote manually, in case of mal-operation of main control valve.

6.02.06 CEP MINIMUM RECIRCULATION

- i) Individual minimum condensate recirculation lines have been envisaged for 3x50% capacity condensate pumps at the upstream of the discharge check valves.
- ii) Minimum recirculation flow control valves are provided in the recirculation lines from condensate pumps to hotwell to ensure minimum flow requirement of condensate pumps especially during start up and low load conditions.
- iii) The control valve modulates when measured flow is varying between 0 T/hr to speed dependent set point of minimum recirculation flow and it closes fully when measured flow exceeds this speed dependent set point.

6.02.07 DEAERATOR OPERATION

- i) Normally deaerator is supplied with steam from IP turbine extraction
- ii) Deaerator pressure varies as per extraction pressure at varying loads.
- iii) De-aerator pegging pressure for cold, warm, hot start up and during HP-LP bypass operation, shall be as optimized by the bidder and shall be suitable to ensure required deaeration and water quality required for boiler. The optimized pressure should be same during warm, hot start up conditions and during HP-LP



bypass operation. Steam is supplied from aux. steam header through pressure control valve.

- iv) With the increase of parameters of CRH steam, extraction to deaerator shall be shift to CRH. Steam source to deaerator will shift to IP extraction when sufficient pressure will be available.

6.02.08 DEAERATOR LEVEL CONTROL

- i) During initial start-up & upto about 30% load, single element condensate control system using deaerator level signal is used for regulating condensate flow. During this operation low load control valve is in service.
- ii) The deaerator level measured signal is compared with deaerator level set point. The error signal from the single element controller positions the low load control valve. When low load control valve is fully open (>85%), and the condensate discharge header pressure is more than 20 kg/cm²(g) (adjustable), the full load motorized regulating valve is opened automatically.
- iii) After ensuring that the full load motorized regulating valve is fully opened, control shall be transferred from single element to three-element control. Low load control valve gets a closing command. The Pump speed shall be modulated based on the signal from three-element control.
- iv) When the unit load is reducing and falls to about 30% and/or condensate discharge header pressure reduces below than 20 kg/cm²(g) (adjustable), then the full load valve will get a closing command and the low load control valve shall open automatically. All controls shall be transferred to low load control valve.
- v) The Normal level in the deaerator is maintained with three element control circuit by regulating speed of the CEP through variable frequency drive (VFD).
- vi) Three element of control system are:
- Feed water flow.
 - Condensate flow.
 - Deaerator level.
- vii) The error signal produced between measured deaerator level and deaerator level set point is added to the feed water flow signal to form the condensate demand signal i.e. set point for condensate flow. This is compared with the condensate flow. Deviation if any will change the condensate controller output which provides the desired speed signal for VFD of individual condensate extraction pumps. Variation in pump speed will contribute to change the condensate flow required by the three element control system.
- viii) CEP Discharge Header pressure shall be maintained above 20kg/cm² (g) (adjustable), under all operating condition. If the discharge pressure goes below 20kg/cm²(g) (adjustable), an alarm is given in the control room and control valve shall come into service and the motorised valve shall close and the control shall transfer from three element control to single element control. The Pump speed shall be modulated such that the Header pressure does not fall below 20 kg/cm² (g) (adjustable).



6.02.09 BOILER FEED PUMP

i) *Changeover Philosophy*

- a) 1x 50% Motor Driven Boiler Feed water Pump is used during initial clean-up & plant start-up.
- b) At low load feed water flow is controlled by 1x30% control valve. MDBFP speed will be varied to maintain DP (5 Kg/cm²) across FCV to maintain the water separator level. Above 30%load, 1x100%/2X50% MOV is opened and water flow is controlled by varying the BFP (boiler feed water pump) speed.
- c) 1st TDBFP will come in service at around 20% load when required steam parameters as required for TDBFP is available.
- d) After 1st TDBFP comes in service MDBFP scoop position will come down to minimum position & will come in hot standby mode and running TDBFP will maintain water separator level.
- e) Stop command to MDBFP will be issue by the operator based on running status of TDBFP.
- f) 2nd TDBFP will be come in service at approx. 50 % Load.
- g) In case one TDBFP is tripped, then one TDBFP and one MDBFP can operate to cater feed water flow at BMCR.
- h) During the shutdown, 1st TDBFP is shut down at 50% load and MDBFP comes in service below 20% Load and simultaneously 2nd TDBFP is shut down below 20% load.

ii) *Run Back Operation*

- a) In case when both the TDBFP's are running, MDBFP shall be kept in Hot standby mode.
- b) In case when one TDBFP trips, runback shall be initiated to 75% Load. Simultaneously MDBFP On command shall be issued. If MDBFP on feedback is not received within 5 sec(adjustable)then runback set point shall be changed to 60% Load. In this case one TDBFP will cater the demand. If MDBFP will come in service then run back command will be stopped and one MDBFP & one TDBFP will cater the load demand of 100%.
- c) If One TDBFP is in operation and MDBFP is in recirculation mode and if suddenly running TDBFP trips then load shall be maintained at 50%. If MDBFP will not contribute in system in 15 sec(adjustable) then MFT shall be initiated.
- d) If One TDBFP is in operation and MDBFP is in standby mode (i.e. Motor off condition) then if suddenly running TDBFP trips then immediately MDBFP will be started. If MDBFP 'ON' feedback is not received within 5 sec(adjustable), then MFT will be initiated on all BFP trip. However, if MDBFP 'ON' feedback is received within 5 sec (adjustable), then MFT will be defeated and within next 10 sec(adjustable), if MDBFP is not able to contribute the feed water in system then MFT will be initiated again.



- e) No BFP trip will be initiated on Separator level high-high, BFP shall be run in recirculation.

iii) *BFP Minimum Recirculation Control*

- a) Individual minimum feed water recirculation lines have been envisaged at the upstream of the discharge check valves.
- b) BFP minimum Recirculation valve shall be of control valve type – Automatic recirculation valve.
- c) Control valves are provided in the recirculation lines from the boiler feed pumps to deaerator to ensure minimum flow requirement of BFP's especially during start-up & low load conditions.
- d) Flow transmitters provided for individual BFP flow measurement shall measure the flow and initiate pump recirculation by opening the minimum recirculation control valve as per speed dependent set point of recirculation flow.
- e) The minimum recirculation valve gets automatically closed, whenever the flow exceeds flow dependant set point with adjustable margin.

6.02.10 LEVEL CONTROL OF HP/LP HEATERS

i) *HP Heaters*

- a) The basic need of level control in heater is to maintain NWL (Normal water level) for the safe and smooth working of turbine. The normal levels in HP heaters are maintained by normal level controller by cascading the drain to next lower heater through control valve.
- b) In case level reaches low level set point, an alarm is initiated in the control room.
- c) If the level reaches high-level set point due heater tube leakage or due to some malfunction, an alarm is initiated in the control room.
- d) The level is controlled by taking drain directly to condenser through emergency level control valve. When the high level control comes into operation to open emergency drain to condenser, the normal drain control valve will also remain open.
- e) If the level reaches high high-level set point, complete heater stream isolation starts and command shall be given simultaneously for the following actions.
 - 1) Close command to Extraction steam motorised isolating valves for all heaters in the corresponding stream.
 - 2) Command will be given to open the feed water bypass line to bypass the complete stream of heaters. This will occur based on the arrangement as provided by the Bidders.
 - 3) Alternate drain Control valve of affected HPH to open fully.
 - 4) An Alarm will be initiated in control room.
 - 5) Requirement of closure of higher HP heater drain to affected heater



ii) *LP Heaters*

- a) The basic need of level control in heater is to maintain NWL (Normal water level) for the safe and smooth working of turbine.
- b) The normal level in LP heater is maintained by normal level controller by cascading the drain to lower heaters through control valve.
- c) In case level reaches low level set point, an alarm is initiated in the control room.
- d) If the level reaches high-level set point due to minor heater tube leakage or due to some other malfunction, an alarm is initiated in the control room.
- e) The level is controlled by taking drain directly to condenser through emergency level control valve. When the high level control comes into operation to open emergency drain to condenser, the normal drain control valve will also remain open.
- f) If the level reaches high high-level set point, heater isolation starts and command is given simultaneously for the following interlock actions.
 - 1) Close command to extraction steam motorised isolating valve for affected heater
 - 2) Alternate drain Control valve of affected heater to open fully.
 - 3) Forced closure of power assisted NRV in extraction line through ATRS.
 - 4) An Alarm will be initiated in control room.
 - 5) To open motorised condensate bypass valve of affected heater and once the bypass valve starts opening (not closed status sensed by limit switch), closing signal shall be given to motorised condensate isolating valves at inlet and outlet of affected heater.
 - 6) Close command to Normal drain control valve from higher LP heater.

6.02.11 OVERALL UNIT OPERATION:

- i) It is envisaged to start up the complete unit including offsite auxiliaries through single click/pushbutton operator action.
- ii) Unit Run without BRP in service and shall be demonstrated 3 times during commissioning.
- iii) SOFA YAW mechanism shall be supplied remote operation with necessary instrumentation and control for fine tuning of combustion

7.00.00 QUALITY ASSURANCE AND CONTROL

7.01.00 All materials, components, structures and equipments covered under this specification shall be tested/checked at all stages of procurement, manufacturing, construction, erection, commissioning as per a comprehensive quality assurance programme.

7.02.00 The bidder including his suppliers and sub-contractors shall prepare their quality plans in line with the requirements of the specification and standard practices



and implement it after approval by the owner and owner's consultant. This will include both Manufacturer's Quality Plans (MQPs) and Field Quality Plans (FQPs). MQPs and FQPs shall be submitted well in advance so that the same can be reviewed and approved by owner/owner's consultant well in advance before start of works.

- 7.03.00 Manufacturing quality plan shall detail out, for all the components, equipments & items various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by bidder's quality control organization, the relevant reference document and standards, acceptance norms and inspection documents raised etc. during all stages of material procurement, manufacture, assembly and final testing/performance testing.
- 7.04.00 Field quality plans shall be submitted and shall detail out for all the items, the quality practices and procedure etc. to be followed by the bidder's site quality control organization during various stages of site activities including receipt of materials/equipments at site, preservation and storage, pre-assembly, fabrication, construction, erection, pre-commissioning and commissioning. The bidder shall provide all necessary means for execution of inspection and testing, according to the requirements including specialised instruments if any.
- 7.05.00 The bidder has primary responsibility for ensuring the quality of items of equipment supplied under the contract and remains accountable when manufacture or erection is subcontracted.
- 7.06.00 It is therefore a requirement of the specification that work is only subcontracted to companies with effective quality control organizations and that the bidder monitors the performance of these by the attendance at tests of experienced inspectors employed by the bidder. The bidder shall, at the appropriate time, prove that his material and/or equipment comply with all the requirements of this specification, such proof being the successful completion of tests and inspections.
- 7.07.00 Routine test and type test certificates shall be submitted for each item of equipment, wherever applicable.
- 7.08.00 All materials, components and equipment supplied under the contract shall be subject to inspection by the owner, his authorised representative or any statutory authority like IBR inspector, should they so require during manufacture, construction, erection and after completion.
- 7.09.00 No materials/equipment shall be dispatched from the manufacturer's works before the same is either accepted subsequent to pre-dispatch final inspection including verification of records of all previous tests/inspections by the owner/owner's authorized representatives, or such pre-dispatch final inspection is waived by the Owner and dispatch is authorized after review of test reports.
- 7.10.00 All materials used or supplied shall be accompanied by valid and approved material certificates and test and inspection reports and dispatch clearance duly approved by the Owner. These certificates and reports shall indicate the acceptable identification number of the material they proposed to certify. The material certified shall also have the identification details stamped on it.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 7.11.00 All material used for equipment construction including castings and forgings etc. shall be of tested quality as per relevant codes/standards. Details of results of the test conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedures recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.
- 7.12.00 All the sub-vendors proposed by the bidder for procurement of major bought out items including castings, forgings, pumps, heat exchangers, semi finished and finished components/equipment - (list of which shall be drawn up by the bidder and finalized with the owner) shall be subject to owner's approval.
- 7.13.00 All welding shall be carried out as per welding procedure drawn and qualified in accordance with requirements of ASME Section IX. Welding procedures shall be submitted to the Owner for approval prior to carrying out qualification test in the presence of Owner's representative.
- 7.14.00 All welders/welding operators employed on any part of the contract either in the Supplier's works or at site or elsewhere shall be qualified as per ASME Section-IX.
- 7.15.00 Test results of qualification tests and specimen testing shall be furnished to the Owner/owner's authorized representative for approval. However, wherever required by the Owner, tests shall be conducted in presence of Owner's/owner's authorized representative.
- 7.16.00 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 7.17.00 The type and extent of inspection of items shall be in accordance with the relevant International/Indian Standards/Indian Boiler Regulations and other standards approved by the owner/owner's representative, supplemented or amended by the requirements of this section of the specification or as specified elsewhere in the Specification.
- 7.18.00 Wherever owner's/owner's representative's (inspector) witness is required as per approved quality plans or inspection categorisation plans, the owner and owner's representative shall be notified (inspection call) along with all required details including details of item to be inspected, approved MQPs, address/place of inspection, inspection date etc, at least 21 days in advance, prior to the planned inspection date at manufacturer's works. All test reports and supporting documents shall be made available to owner's inspector at the time of inspection; irrespective of whether it has been furnished earlier.
- 7.19.00 All site inspections as per approved FQP shall be notified along with all details including details of item to be inspected, location, inspection protocols etc., at least 5 working days in advance.
- 7.20.00 The owner/owner's representative, within fifteen days from the date of receipt of such notice/inspection call, shall intimate the bidder, the probable date of visit for the inspection. All efforts shall be taken by the owner to ensure that such date shall not be later than eight days from the date of inspection as intimated by the bidder.



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- 7.21.00 If the owner or his representative does not attend on the notified date or in the event the owner grants waiver for such inspection, the test may be proceed as per approved quality plan, unless an alternative date has been requested by the Owner.
- 7.22.00 Participation by owner/owner's representative in or their absence from or failure to participate in any Tests (other than the Performance Tests) shall not relieve or absolve the Bidder from any Guarantee or Warranty or obligations of services under or in pursuance of the contract.
- 7.23.00 In the event, the inspector could not witness the inspection on the scheduled date for the reasons attributable to the bidder/subcontractor; all the costs of deputing the inspector shall be borne by the bidder.
- 7.24.00 With respect to site inspections, the bidder shall, wherever required, give due notice to the owner/owner's representative whenever work is ready before covering up or putting out of view. The inspector shall then either carry out the inspection, examination, measurement or testing or notify the bidder that it is waived.
- 7.25.00 If the inspector is not satisfied with any test and requires a re-test, the tests shall be repeated under the same terms and conditions. If such retesting demonstrate that the work, equipment or material being so tested conforms to the requirements of Contract, then the owner shall bear the cost of such additional Test and the cost of any required uncovering and covering the goods and shall grant the extension of time for completion, if necessary. If however such retesting confirms inspector's conclusion and cause the owner to incur additional costs, such costs shall be recoverable from the bidder.
- 7.26.00 If, as a result of inspection, examination or testing, the inspector decides that any equipment, system, materials, design or workmanship has failed in such inspection, examination or tests or is defective or otherwise not in accordance with the contract, the inspector may reject such equipment, system, materials, design or workmanship and shall notify the bidder promptly, stating his reasons. The bidder shall then promptly correct or replace, such item or portion so as to pass retesting and otherwise meet and conform to such requirements. No changes to project schedule or increase in the price shall be granted with respect to such additional testing. Bidder shall bear any cost resulting due to such rejections.
- 7.27.00 Notwithstanding anything contained hereinabove, the pressure parts of the boiler coming under the ambit of statutory inspection (IBR), shall be carried out by the owner's personnel only.
- 7.28.00 Reference to special codes and standards, where designated either directly or as "relevant", is intended to provide a measure of performance, safety, in-shop and on-site testing, and methods of construction and/or installation which must be equal or superior in order to be considered acceptable for use under this specification. If more than a single degree of quality or accuracy is permitted within the scope of particular code or standard, the highest quality shall be applicable and the degree of accuracy commensurate with the intended function shall be selected, but with the understanding that the final decision will be made by the Owner.



7.29.00 The bidder shall include in its proposal a comprehensive Quality Assurance Programme containing the overall quality management and procedures which it proposes to follow in the performance of the works to maintain the quality of product during various phases.

7.30.00 At the time of award of Contract, the detailed Quality Assurance Programme to be followed for the execution of the Contract will be mutually discussed and agreed to and such agreed programme should form a part of the Contract.

7.31.00 Test Certificate and Documentation

7.31.01 The results of all tests shall be certified by the manufacturer, bidder or independent agency as appropriate.

7.31.02 On completion of the inspection/tests, the bidder shall furnish the inspection report and test certificates as per the approved quality plans to the owner for approval and despatch clearance. The test reports shall invariably indicate identification data, including Model No., S. No., Billing Break-up reference etc. of the equipment, method of application and duration of test along with test results.

7.31.03 Document files containing material certificates, welding procedures, test report etc. shall be compiled for each item of plant and shall be suitably identified (including equipment classification reference) and bound.

7.31.04 Four copies of each document file containing inspection reports and certificates of site erection testing activities of a particular item of plant or system shall be supplied to the Owner prior to commissioning.

7.31.05 Copies of the performance and acceptance test reports shall be prepared and distributed as specified in Clause 'Performance and acceptance test data and reports' of this Section. All documentation as required by IBR shall also be prepared and submitted.

7.31.06 Soft copies of above shall also be submitted.

8.00.00 PROJECT MANAGEMENT

8.01.00 The bidder shall be responsible for the overall management of the project.

8.02.00 The bidder shall submit a project management plan, within 30 days from the date of award.

8.02.01 The main objective of the document is to indicate how the various elements of the project like engineering, procurement, sub-contracting, transportation, site execution, quality control, commissioning and performance testing are planned and integrated.

8.02.02 The plan shall be in line with the project milestone schedule.

8.02.03 This plan shall contain the following:

- i) Project Management Organisation Structure – Indicating the responsibility centres at both home office and site office, for engineering, procurement, sub-contracting and transportation. System/area wise and discipline wise responsibilities.



- ii) Site Organisation Structure – Indicating system/area wise and discipline wise responsibilities, for site management, planning, site execution, administration, quality control, safety, commissioning and performance testing including material management and Billing.
 - iii) Transportation Logistics – Planning logistics and identification of Over Dimension consignments (ODC) and its transportation strategy.
 - iv) Construction Methodology, Erection Strategy and Deployment of T&P and resources – A detailed erection strategy showing delivery plans, sequential erection activities supported by T&P and manpower deployment plan, indicating quantities and time period. This shall also indicate time schedule for finalisation of erection agencies/sub-contractors.
 - v) Any other information reasonably requested by owner.
- 8.02.04 Curricula Vitae of key personnel, who will be part of project during various stages, shall be submitted to the owner and make suitable changes if suggested by owner. Any change of the key personnel or organisation structure shall promptly be communicated to the owner.
- 8.02.05 This plan shall be mutually agreed between the owner and the bidder.
- 8.03.00 Project Schedule, Planning and Monitoring**
- 8.03.01 The Bidder shall prepare a Master Network Schedule in the form of PERT network. The network shall be prepared on a Work Breakdown Structure.
- 8.03.02 The master network shall identify milestones of key events of each system in the areas of engineering, procurement, manufacture and despatch, erection and commissioning. The master network shall represent the Level I (L1) Schedule and will form the basis for development of detailed second and third tier execution plans i.e. L2 and L3 network schedules.
- 8.03.03 The master network shall be submitted along with the bid and shall be mutually discussed and finalised before the award of Contract. The master network shall identify a complete list of inputs to be furnished by the Owner which may be required for proper interfacing and tie up. Scheduled dates for providing such inputs shall also be indicated and the same will be mutually discussed and finalised.
- 8.03.04 The Bidder shall not change the Master network without the prior approval of the Owner in accordance with the Conditions of Contract. In the event that the Owner approves a revision to the Master Network in accordance with the Conditions of Contract, the Bidder shall submit a revised Master Network within two weeks thereafter. This programme shall fully comply with the requirements of the specification and where necessary, reflect changes to the sequence or progress of the Works as indicated by the Owner or as proposed by the Bidder and accepted by the Owner. Such an agreed revised programme shall become the overall schedule for the outstanding works.
- 8.03.05 The Bidder, within 30 days after the date of award of contract shall submit to the Owner the detailed L2 schedule and within 90 days from the date of award of contract shall submit the detailed L3 schedule for the package, which shall be consistent with the Project Schedule given above.



- 8.03.06 The schedule shall show the sequence, timing and duration of the Work and the planned commencement and completion dates of all separable portions of the Work, including each Milestone, in form, content and level of detail satisfactory to Owner. The Bidder shall fix the major milestones to check / review progress on the life cycle curves so that the time gap between 2 milestones should not be more than 10% of the total time duration.
- 8.03.07 Along with the L2, detailed sequential supply schedule shall also be submitted and shall be mutually agreed between the Bidder and Owner. All supplies shall be purely sequential based on its requirement at site.
- 8.03.08 The Bidder shall at all times perform the scope of supply in accordance with Project Schedule and the programme.
- 8.03.09 No material alteration to the Programme shall be made without the approval of the Engineer. However, Bidder may make minor alterations to the Programme without the prior approval of the Engineer being required where such alterations are consistent with the key milestone dates set out in the Project Schedule.
- 8.03.10 The Bidder shall submit the coding procedure being adopted for computerisation along with the logic and the Work Breakdown Schedule with their respective weightages used for generating the life cycle curves and shall submit the Work Intensity Chart based on weightages conforming to their overall schedule.
- 8.03.11 If the progress of the Scope of Supply or any other part of the Works does not conform to the Programme, the Owner may instruct the Bidder to revise the programme.
- 8.03.12 If for any reason which does not entitle the Bidder to an extension of time the rate of progress of the Scope of Supply or part thereof is at any time in the reasonable opinion of the Owner or the Engineer too slow to secure completion of the works within the Time for Completion or any extended date the Employer may so notify the Bidder in writing and the Bidder shall thereupon take such steps as are necessary and the Employer may approve an order to accelerate (whether by re-programming the order or sequence of work or by increasing the personnel or other resources of the Bidder or its sub-contractors employed on the Scope of Supply) the progress of the Scope of Supply or part thereof so as to achieve completion of each section by the Time for Completion as may be extended. The Bidder shall not be entitled to any additional payment or extension of time for taking such steps.
- 8.03.13 During the performance of the Work, Bidder shall submit monthly updates comparing the Work completed against the milestone schedule or if Bidder's performance is not in compliance therewith, more frequently as requested by Owner. If Bidder's performance of the work is not in compliance with the Milestone Schedule, without restricting any other rights or remedies of Owner hereunder, Bidder shall
- i) Submit its plan for schedule recovery and
 - ii) Specify in writing the steps to be taken to achieve ongoing compliance with such revised schedule.
 - iii) Bidder shall submit the overall life cycle curve for progress curve. The Bidder shall adopt a milestone approach and shall identify several milestones to be



achieved so that they could be measured physically. Computation of progress of the Bidder shall use weighted value concept and submit detailed computerised linked bar chart. Bidder shall submit work breakdown structure in detail along with the weightage and the milestone to be achieved every week preferably in a graphical / tabular format.

8.03.14 Bidder shall comply with the Schedule and to attend and participate in progress, site co-ordination or special purpose meetings. Progress, site and co-ordination meeting will be held at Bidder's engineering office or the Site on a weekly basis, unless otherwise requested by Owner. Bidder shall have in attendance at any such meeting the Project Manager and other management workers authorised to commit additional manpower to the Work and shall for any progress meeting bring a forecast showing the last period's progress versus the last period's scheduled work plan and the work plan for the next one month period. Unless otherwise stated in writing by Owner the forecast shall describe the Work by task, by site location, by area or building and by bay for a one month period. The commencement and completion of each task to be performed shall be clearly designated. If requested by Employer, representatives of Vendors of major materials shall be present at each such meeting. Employer may on reasonable notice to Bidder call a special purpose meeting whether at Bidder's engineering office or the site to review any portion of the Work, the performance of which is of substantial concern to Employer.

8.03.15 The Bidder shall use the latest version of a project management software preferably like MS project/Primavera to generate and submit the following (both hard copies and soft copies) to the Owner to facilitate monitoring the project progress:

- i) Overall Schedule (on Monthly basis) hard copy and soft copies.
- ii) Performance / Forecast look ahead schedule i.e., three weeks work ahead and previous week's performance. This shall be submitted and monitored every week.
- iii) Milestone slippage report, if any.

9.00.00 SITE AND LAYOUT REQUIREMENTS

9.01.00 Plant Area

9.01.01 SITE AND SOIL PROFILE

- i) A preliminary soil investigation and topographical survey has been carried out by owner. The details are furnished in Annexure 5 and 6 of Volume – V.
- ii) The detailed geotechnical investigation, topography and setting out survey for the area covered under this package will be performed by the bidder, and will be the basis for the detailed engineering for the project. The geotechnical report shall contain recommendations for foundation design during detailed engineering.

9.01.02 LAYOUT OF SITE

- i) A suggestive plot plan indicating available area is enclosed as Annexure – V, 1. However, the bidder shall further elaborate and prepare a detailed layout



arrangement which will be subjected to approval of the owner.

- ii) In developing the site layout, a systematic approach shall be adopted with a view to ensure that all the subsystems comprising the package are optimally laid out both from the view point of capital cost as well as running/operating costs.
- iii) Ease of operation and maintenance of the plant will be the most important aspect to be considered while developing the layout.
- iv) The detailed layout shall be prepared by the bidder taking into consideration the most economical option, considering the requirements of the specification, functional requirements, optimum space utilisation and transportation/storage/construction/erection strategies.
- v) The area for construction/erection facilities like lay-down, pre-assembly, offices and stores is to be managed by the bidder within the overall area available and allocated within plant boundary. In case bidder requires additional area, he shall make his own arrangement at his own cost outside the plant boundary. Development of the same including security etc. for the intended use will also be his responsibility.
- vi) The spacing between various buildings and facilities shall be suitably decided so as to avoid interference between the foundations.
- vii) Face of the buildings and facilities shall be located in such a way so as to have an offset of minimum 15 m with respect to centre line of double lane road and 12 meter with respect to centre line of single lane road.
- viii) In case of rail track minimum 3m horizontal clearance between face of adjacent structure to centre line of rail and 8.5m vertical clearance between bottom of structure to top of rail shall be maintained. Further as per the practice adopted in railways, any crossing below the rail track, minimum opening size of culvert shall be 2.0m wide X 1.8m deep. A walkway of min600mm width shall also be made available in the culvert.
- ix) The development work consists primarily of clearing the site, grading the site to appropriate levels keeping in view the planning for storm water drainage and green belt.
- x) Coordinate system shall be N-S / E-W or as mutually agreed and shall be in meters. Elevation shall be in meters.
- xi) All statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local bye-laws are met.

9.01.03 SITE LEVELLING AND GRADING

- i) Finished Floor Level (FFL) of Power House Building shall be RL (+) 82.2 m above MSL.
- ii) Finished grade level (FGL) of the site shall be 500 mm below from FFL.
- iii) Finished Ground Floor (FFL) Level of Power House building taken as EL 0.00m corresponds to RL (+) 82.2 m above MSL.
- iv) Paved level (top) in boiler & ESP area shall be at EL (-) 0.20m.
- v) Paved level (top) in transformer yard shall be at EL (-) 0.20m.

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SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- vi) FFL of ESP/FGD control building and other buildings in boiler/Mill bunker building/chimney area shall be EL 0.00m.
- vii) Top of road shall be EL(-)0.30mm.
- viii) FFL of offsite buildings shall be 500mm above FGL of respective areas.
- ix) Fuel storage tanks, hydrogen cylinder rooms, etc. Shall be designed in accordance with statutory agencies guideline
- x) All the buildings and facilities shall be approachable by fire tenders
- xi) Site shall be cleared as required for construction. Trees if any may be retained if it will not obstruct the plant construction.
- xii) Site shall be excavated and unwanted debris if any shall be removed.
- xiii) Earthwork in excavation including quarrying/blasting as required, identifying borrow pits, transportation of soil from borrow pits, backfilling and disposal of excavated material shall be carried out by bidder.
- xiv) Backfilling after removal of all debris and further compaction to maintain the FGL shall be done, as required.
- xv) Necessary grading/levelling required for the construction shall be done by the bidder. The area shall be suitably cut and filled to suit the layout requirement as required.
- xvi) All statutory requirements including safe distances between various facilities as per applicable rules / acts / laws including local bye laws shall met.

9.01.04 ROADS, BOUNDARY WALL AND FENCING

- i) Granular sub-base (GSB) layer for roads shall be constructed after levelling and grading of the site, for easy movement of plant men and material including cranes and other construction equipments. Preferably all road crossings shall be planned, designed and completed before laying of GS Broad.
- ii) Roads as required inside the plant for easy access of men and material to various locations shall be provided. Considering the Layout requirements, modifications in the existing plant roads are to be carried out with new connecting roads as shown in the Plot Plan for approach to the various areas in 1x800 MW plant. The approach road from canal service road including canal cross over bridge is in scope of bidder.
- iii) Drains shall be provided both sides of roads except patrolling road. Drain shall be provided one side of patrolling road.
- iv) All roads shall be rigid pavement with RCC.
- v) BTG island roads shall be 10m wide with 1.5m shoulder on both sides.
- vi) Main road from Gate-2 to Power plant area shall be 15m wide including 1m divider with 1.5m shoulder on both sides.
- vii) All other roads for inside the plants shall be 7.0m wide with 1.5m wide shoulder on both sides.
- viii) Each building access shall be provided minimum 5m wide road.
- ix) Patrolling road shall be 4m wide RCC road.

**9.02.00 Layout of the plant area**

9.02.01 The following factors shall be considered in developing the plant layout for all area:

- i) Safety of personnel and plant is the most important criteria for plant layout.
- ii) Optimisation of resources and ease of operation and maintenance are the other important criteria.
- iii) Easy and safe access to all areas shall be provided for smooth operation of the plant. Especially, adequate access shall be provided to all valves.
- iv) Similarly adequate provision shall be provided for convenient maintenance of the all items of the plant. This is very important in order to reduce the equipment/plant downtime and increase the equipment/plant availability.

9.02.02 Due consideration shall be given for the wind direction while deciding on the relative location of Cooling tower and switchyard to minimize the moisture drift towards the switchyard.

9.02.03 Control Room / Control equipment room {for placing control and power system panels, including remote I/O (RIO)} for all areas shall be provided as near as possible near to their respective area MCC/Switchgear. Control Rooms / Control Equipment Rooms / RIO rooms shall be air-conditioned. Batteries for power supply systems as required shall be placed in separate suitably ventilated Battery rooms.

9.02.04 Adequate space shall be provided for unloading and maintenance purposes in Turbine - Generator (TG) area. Requisite lay down area shall be provided on TG floor and same shall be approachable with electric overhead travelling (EOT) crane.

9.02.05 The bidder shall furnish GA drawings indicating the equipment laydown area with details such as blocks indicating orientation of dismantled items, travel path etc.

9.02.06 The bidder shall also furnish GA drawings indicating the laydown arrangement of major assemblies (provided as spares) in the TG hall, with access from EOT crane. If the area provided inside TG building is not sufficient to accommodate these unit assemblies then a separate buildings shall be provided. The layout and arrangement shall be furnished along with the bids submitted by the bidder.

9.02.07 Adequate provision shall be made at all areas, in regard to space and access, in order to carry out the maintenance of various equipments. Adequate maintenance facilities & access shall be provided as required, for assembly, disassembly, handling during maintenance and alignment work of all important equipment and auxiliaries viz: dampers, actuators, field instruments, steam turbine casing (inner and outer), diaphragm glands, steam valves, journal/thrust bearings, turbine rotors, generator rotor, end rings, shaft seals, generator bearings, hydrogen coolers, condenser water box, condenser cooling water line inlet and outlet motor operate butter fly valves, vacuum pumps, CEPs and BFP cartridges, BFP drive motor, turbine oil coolers, pumps, fans, air pre heaters, boiler circulation pumps, regenerative heater, coal mill, coal feeder etc.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 9.02.08 Cut-outs as required and lay down space for all the equipments shall be considered and lifting and handling equipments shall be extended up to the lay down space
- 9.02.09 Adequate fire escape staircases shall be provided in power house building with fire doors at each landing.
- 9.02.10 Adequate no. of staircases and access through elevator shall be provided as required and specified for various buildings.
- 9.02.11 Adequate number of permanent stores and open paved yard shall be provided as per requirement of the Station for storage of spares and materials etc.
- 9.02.12 The safety requirements as per the Factories Act, Indian Electricity Rules and other applicable codes/standards etc. shall be observed while developing the layout.
- 9.02.13 Steel storage yard and pre-assembly yard required for storing and assembling of plant equipments during construction phase and later this space will converted into open storage/green belt during the operational phase.
- 9.02.14 Crisis Management scheme and Emergency Management scheme shall be provided. This is related to plant and personnel safety during construction and operation in relation to layout features, operational features and accidents. The details shall be discussed and finalized during engineering stage.
- 9.02.15 Sufficient clear head room of minimum 2.1m shall be provided in all area.
- 9.02.16 Valves shall be located in accessible positions. All piping shall be routed at a clear height of minimum 2.5 m from the nearest access level for clear man movement. Best engineering practices shall be adopted for keeping the minimum clear working space around equipment and clear headroom within main structures and cable trays etc.
- 9.02.17 Space for pipe racks and pipe pedestals shall be considered while planning the layout.
- 9.02.18 Equipments / systems shall be so oriented that any maintenance work as well as subsequent construction work can be carried out without any interference and/or hindrance to the operational equipment / system.
- 9.02.19 All facilities of the unit are to be laid out in close proximity to each other to the extent practicable so as to accommodate all facilities efficiently within the plant boundary.
- 9.02.20 The layout shall also facilitate communication of men and materials between the various facilities both during initial construction and also during subsequent operation and maintenance.
- 9.02.21 Cross over ladders shall be provided at all suitable places wherever pipe/cable (laid over pedestals and floor level) has to be crossed.
- 9.02.22 Hand rails of suitable height and toe guards shall be provided for all platforms/walkways/ladders.
- 9.02.23 Minimum clear gap of 1200mm shall be provided between equipment foundations/columns/pipes/cable racks/pedestals/walls/trenches etc otherwise specified elsewhere.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 9.02.24 Minimum clear width of all staircases shall be 1200mm.
- 9.02.25 Easy access to shift material and equipments to and from buildings should be provided.
- 9.02.26 Easy approach for vehicles to handle the equipments near maintenance bay shall be provided.
- 9.02.27 Each equipment room / building shall be provided with alternate exits in case of fire/accidents as per requirements of factory act and TAC. Further minimum two number fireproof double doors shall be provided in Cable vaults and HT/LT switch gear room.
- 9.02.28 One set of washroom/toilet to be provided in the control room floor of respective buildings. Separate washrooms/toilets at suitable locations shall be provided for male, female and transgender.
- 9.02.29 Pantry with suitable ventilation, sink and power supply points and platforms for induction stove and microwave oven to be provided adjacent to control rooms in respective buildings.
- 9.02.30 Below ground basement rooms shall not be considered.
- 9.02.31 All equipment shall be installed above ground. Below ground installation will not be allowed, but if a below ground installation is unavoidable, then proper maintenance space and dewatering arrangement has to be provided. Collection of oil and dirt in that area has to be avoided and it should be easy to clean such a place.
- 9.02.32 Layout and Landscaping should be aesthetically planned and provided for the project.
- 9.02.33 **POWER BLOCK AREA**
- i) The following building / structures & equipment shall be located within power block:
 - a) Steam Generator area
 - b) Steam Turbine Generator Hall
 - c) Control & switchgear building
 - d) Power Cycle Pipe Rack & Cable Gallery
 - e) Transformer yard area
 - ii) The suggested general arrangement concept of power blocks are shown in plot plan. Bidder shall develop an optimized layout of the power blocks to suit the configuration and equipment offered, subject to approval of Owner/Consultant.
 - iii) Clear walkways of minimum 1.5m width at all the levels shall be provided in the main plant building. Adequate fire escape staircases shall be provided in main plant building with fire doors at each landing.
 - iv) For EOT crane maintenance, through walkway shall be provided along both rails at crane girder level. Approach to the crane through rung ladders shall be provided at least at two places.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- v) Steam turbine, generator, Lube oil system, CEP, and other equipments located in the turbine hall shall be accessible by the EOT cranes for their handling during maintenance and overhauling. For all other equipment/ components located in the main plant building, suitable handling arrangement viz. cranes/monorail hoists etc. as required shall be provided for the maintenance and overhauling. Wherever special handling procedures are to be followed, the same shall be described in a separate document.
- vi) Floor drains shall be provided at all floors and drain discharge pipes shall be properly sized taking into account the fire water sprinkler system wherever provided.
- vii) All drains shall be routed to adequately located and sized pits and shall be provided with automatic 2x100% pit/sump pumps for disposal to effluent collection pit at various locations. Suitable access shall be provided for maintenance all pits.
- viii) Electrical bays shall be provided in power house/control building for each unit to house switchgear room, cable spreader room, battery room etc. Switchgear room shall accommodate HT switchgear, LT switchgear, and Dry type transformers etc. for the main plant electrical system. Each switchgear room shall have cable spreader room below the switchgear. Minimum floor height of the cable spreader room shall be 3.5m.
- ix) The cable vault space/cable spreader room below HT/LT switchgear rooms, control rooms, unit control equipment room, Programmer room, UPS, Charger & Battery rooms, MCC room shall have minimum 800mm wide and 2.1m high movement passage all around the cable trays in the cable vault/spreader room for easy laying and maintenance of cables. Proper segregation/separation of cables shall be provided. Cable trenches are not allowed. False flooring to route cables is not envisaged.
- x) The minimum clearances shall be maintained, taking into consideration ventilation ducts and other structures.
- xi) The Turbine repair bay area shall be sized for minimum of 20 m x 30 m.
- xii) TG maintenance room and tool room shall be provided in TG operating floor or ground floor, with space to store tools and tackles and consumables of TMD.
- xiii) Passage way between power house building 'C' row and boiler 1st row column shall be minimum 15 m wide. Clear height shall be 8m except in control building area, where the minimum head room shall be 5m.
- xiv) Minimum clear approach width between Boiler/Bunker bay and ESP shall be 12m & minimum clear height shall be 8m.
- xv) Minimum clear approach width between ESP and ID fan shall be 10m & minimum clear height shall be 8m.
- xvi) Layout of facilities and equipment shall allow removal of Generator Stator, Generator transformers, Station & Unit transformers without disturbing equipment, piping, cabling, ducts routed in the area.

**9.02.34 STEAM GENERATOR AREA**

- i) The lay down area shall be provided on any one side of SG, which would facilitate easy access for erection and maintenance. Equipments located outdoor shall be provided with covered roof /canopy.
- ii) Power Cycle piping area between power house building C-row and Boiler 1st column shall have canopy / covered with roof.
- iii) Maintenance room for boiler, mills and fans shall be provided, with space to store tools and tackles and consumables of BMD.
- iv) Coal bunker shall be cylindrical in shape.
- v) A clear walkway of 1200mm (min) shall be ensured between the mills / its foundation / mill reject conveyors and inner face of mill bay column. Maintenance space shall be provided on either side.
- vi) Mill handling arrangement complete with crane and handling facilities along with removal space shall be provided. For each mill bay, bidder shall provide adequate maintenance area for safely handling the mill equipment/parts. Roof shall be provided above maintenance space.
- vii) Equipment operating/maintenance platforms at Mill Hoist Level, Mill Discharge Valve level, Bunker/Feeder Outlet Level, Cold and Hot air damper level, scanner approach level, oil gun approach level, approach to bottom of hopper for ash handling and for other equipment shall be provided. The platform shall be such that minimum 1.2M space is available all around the equipment for operation & maintenance. However, complete platform for mill maintenance shall be provided at one level in the mill bunker building. Further, 2.1M clear height shall also be available on all such platforms for the person to stand on the platform.
- viii) FD, ID and PA fans handling arrangement complete with crane and handling facilities along with removal space shall be provided. A continuous platform shall be provided between fan and motor end for ID/PA/FD fans in order to facilitate movement of personnel.
- ix) In the SG area, facility of crane/monorail hoist etc. shall be provided along with provision of space for maintenance/ overhauling of equipment such as handling of coils of economizer, motors etc.
- x) Interconnecting walkways between SG and TG building shall be provided at TG various levels. Walkways at various levels shall also be provided for interconnection between steam generator and bunker bay.
- xi) Interconnecting walkway/landing from Boiler to Mill platform and ladder from 0 metre to mill platform shall be provided.
- xii) Approach platform shall be provided from ESP outlet to ID fan suction gate.
- xiii) Separate FGD control building shall be considered. Alternatively, ESP and FGD control building may be housed in the same building and shall be suitably located.
- xiv) FGD system shall be located within the main plant block beyond ESP.
- xv) RCC (Wet stack) Chimney 150m (min.) high shall be located beyond ESP.



- xvi) DeNOx system shall be located in boiler area, Bidder shall submit the details regarding DeNOx system and its location basis clearly in bidding documents.
- xvii) Minimum one staircase shall be provided between two adjacent passes of ESP. These stair cases shall be equally placed between the inlet and outlet of ESP.

9.02.35 Steam Turbine and Generator Hall/Power House Building (PHB)

- i) Adequate space for maintenance of steam turbine/generator and condenser shall be provided in the layout. Requisite lay down area shall be provided for each unit on TG floor and same shall be approachable with Electric Overhead Travelling (EOT) crane. One transverse bay with adequate space shall be provided for each Unit in TG building for unloading and maintenance purposes. TG EOT crane is required to handle the heaviest component other than the generator stator.
- ii) Generator stator shall be lifted using the strand jack method or portable crane.
- iii) The crane rails of the turbine hall shall be at sufficient elevation with adequate clearance from the crane main hook to the operating floor level. Preferably, EOT Crane access shall be made available for all STG Hall equipment. In case certain items do not have EOT Crane access, suitable permanent handling facilities shall be provided for them.
- iv) The operating floor for the STG shall be at suitable elevation level to match the top level of TG deck.
- v) The vertical CEP's, shall be located adjacent to the condenser.
- vi) Preferably Closed cooling water pumps, PHE, Vacuum pumps shall be kept in the ground floor.
- vii) TDBFPs shall be preferably placed at the operating floor, with VIS system.
- viii) Clear walkways shall be provided along 'A' and 'B' row of PHB. Minimum 1.5m wide at all levels of AB bay. And minimum 2.0m wide interconnections with boilers and service building at operating floor level and other levels as required and specified.
- ix) Interconnecting platforms with boiler shall be provided at-
 - a) Operating floor level
 - b) Mezzanine floor level
 - c) PRDS level and
 - d) Deaerator level.
- x) Facility shall be provided for handling of condenser water box to enable maintenance and withdrawal of condenser tubes. Rolling shutter(s) along with extended platform shall be provided to facilitate condenser tube withdrawal.
- xi) Adequate provision for maintenance of regenerative feed heaters shall be provided.
- xii) Corridor for transportation and lifting of Generator Stator outside "A" row column all along TG building shall be considered.



- xiii) Local pits in main plant building shall avoided. However pits/sumps which are unavoidable like CW pits, shall be provided with necessary dewatering arrangements by means of drainage pumps and piping.
- xiv) Below ground basement rooms shall not be considered.
- xv) Required provision for anchoring and load for 400kV conductor stringing from GT to switchyard shall be considered in power house building.
- xvi) Debris filter shall preferably be located above ground with covered shed outside the TG building.

9.02.36 CONTROL AND SWITCHGEAR BUILDING

- i) The control and switchgear building shall be either a separate building or part of power house building. Control room shall be located in the control and switchgear building/tower, towards the boiler side at operating floor suitably located adjacent to the TG hall, considering ease of cable routing and interconnection.
- ii) The control room shall be designed both aesthetically and ergonomically.
- iii) Besides this CCR, control equipment room (CER), programmer room, PC room, UPS/ charger room and battery room shall be provided. Symmetry to be ensured in finalizing CCR, CER, Programmer room, PC room, UPS/ Charger and battery room layouts. Bidder to ensure space to place standalone/common systems in first unit.
- iv) The control and switchgear building shall house the Central control room and control equipment room, electrical switchgear room, relay panel room, UPS room, cable spreader room, battery rooms and air-conditioning system room as well as certain O & M Offices.
- v) Symmetry shall be ensured in finalising CCR, CER, Programmer room, PC room, UPS charger and battery room layout.
- vi) Space shall be ensured to place standalone systems.
- vii) The Central control room shall house the DCS and other electrical control panels
- viii) Computer room with programmer station and associated consoles shall be provided.
- ix) Electric control panels, protection panel etc shall be suitably located.
- x) Independent cabin shall be provided for the Shift In-charge/supervisor.
- xi) Conference room and C&I engineer's room shall suitably located.
- xii) Pantry and dining facility for shift engineers & staff shall be provided at the operating floor level near CCR.
- xiii) 24V DC charger, UPS & Batteries for control room may be suitably placed, preferably below CCR & CER, at mezzanine floor level.
- xiv) Separate wash room for ladies and gents shall be provided near CCR.
- xv) CCR shall not have any internal column inside the room. Large span roof beams shall be adopted for CCR.



xvi) No vertical bracings, pipes, cable shafts etc. shall be routed through control room or CER.

xvii) Following minimum clearances shall be maintained for C&I DDCIMS cabinets:

Internal spacing	1200mm
Clearance from back	1000mm
Clearance from front	1000mm
Clearance from side wall	1000mm

xviii) The electrical switchgear room may be located in the control and switchgear building at sufficient elevation, above the cable spreader room.

xix) AC plant shall be preferably located at the ground floor of the control building.

9.02.37 TRANSFORMER YARD

- i) All power transformers shall be located outdoor.
- ii) Generator transformers, Unit transformer, station transformer, standby Generator transformer, Unit auxiliary transformers, station auxiliary transformer and Auxiliary Transformers shall be located in transformer yard. LT dry type transformers shall be located indoor.
- iii) Adequate distance shall be maintained between the transformers.
- iv) Layout of facilities and equipment shall allow removal of generator transformers, Unit transformer, station transformer, standby maintenance transformer, Unit auxiliary transformers and station auxiliary transformers without disturbing structure, equipment, piping, cabling, bus ducts etc. routed in the area.
- v) Suitable rail track and associated facilities like jacking pads, mooring post / anchor blocks etc. shall be provided in the transformer yard, for each transformer, to facilitate the movement of transformers to and from road.
- vi) Jacking pads shall be provided where the rail tracks changes direction.
- vii) If any pipe is routed underground below the transformer rail foundation, it shall be properly encased.
- viii) Rail track shall be provided for all outdoor transformers up to road, for each transformer of size more than or equal to 7.5MVA.
- ix) When rail track is connected to TG area rail track, rail top shall be at EL 0.00m, corresponding to PHB FFL. And Bus duct support or transformer body shall be at least 8.0 m from A-row of TG building to clear the movement of GT/Stator/UT/ST/UAT on rail line.
- x) Transformers shall be separated from the adjacent building/structure and from each other by a minimum distance, as mentioned below or by a fire wall of minimum two hours fire resistance rating of minimum height 600mm above bushing / pressure relief valve vent, whichever is higher.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

Oil capacity of individual transformer (litres)	Clear separating distance (m)
5,000 to 10,000	8.0
10,001 to 20,000	10.0
20,001 to 30,000	12.5
Over 30,000	15.0

- xi) As a safety requirement, fire wall shall be provided on 'A' row of PHB in front of power transformers.
- xii) For each transformer a pit shall be provided all around the transformer at a minimum distance of 1.5m from transformer edge. A sump pit shall be provided for each pit.
- xiii) A common oil retention pit shall be provided to hold oil quantity of the largest transformer (by volume) and 10 minutes of water quantity from HVWS system for the largest transformer.
- xiv) Sump pits from individual transformer shall be connected to the common oil retention pit.
- xv) In case of auxiliary transformers having an aggregate oil capacity more than 2300 litres, but individual oil capacity of less than 5000 litres, the separating distance between transformers and surrounding building shall be at least 6m, unless they are separated by a fire wall or are protected by high velocity spray system.
- xvi) The transformer fencing shall be at 1.0m (min.) distance from the pit wall. The height of fencing shall be 2.5m (min.) and fencing shall have personnel entry gate and removable type fencing/gate for removal of transformer.
- xvii) IS 1646 / CPIB manual shall also be referred to.

9.02.38 ELECTRICAL MCC & SWITCHGEAR ROOMS

- i) Following minimum clearances shall be maintained for HT switchboards:

	Clear distance (m)
Front clearance	
For one row of switchgear	2.0
For two rows of switchgear	2.5
Back clearance	1.5
Side clearance	0.8 + Space for additional panel



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

VOLUME - II

SECTION - 2

REV. - A

- ii) Following minimum clearances shall be maintained for LT switchboards:

	Clear distance (m)
Front clearance	
For one row of switchgear	1.5
For two rows of switchgear	1.5/1.75m depending upon room size
Back clearance	
For single front	1.0
For double front	1.5
Side clearance	0.8 + Space for additional panel

- iii) HT switchboard clearances shall be maintained wherever both LT & HT switchboards are in placed in the same MCC room.

- iv) Height of HT/LT switchgear room

	Clear height (m)
With bus duct	4.5
Without bus duct	4.0

- v) Size and routing/layout of ventilation ducts shall also be considered while maintaining the clearances.
- vi) Routing of ventilation duct over the panels shall be avoided. In case if it is unavoidable, minimum 200mm clearance shall be provided above the panel and joints should be avoided over the panels.
- vii) For LT switchgear/MCC room at EL 0.00m, minimum 1.4m (wide) x 1.4m (deep) cable trench shall be provided to route the horizontal cable trays.

9.02.39 PIPING AND CABLE ROUTING

- i) Minimum clear height of cable/pipe trestle, within the power block area, i.e. from transformer yard to road behind chimney, shall be 8.0m bottom of steel (BoS).
- ii) Minimum clear height of cable/pipe trestles, at road/rail crossings shall be 8.0m (BoS).
- iii) Trestle height in outlying area shall be 5.0m (BoS).
- iv) Trestles/Pipe rack to be provided for routing of cables, pipes etc. shall have a clear height at road crossings so as to clear the road spaces, approach to maintenance bays of different equipment.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- v) Height of trestles at approach roads to various buildings/ facilities shall be 8m. In case buildings are located in offsite area and are adjacent to each other, then as a good engineering practice, the height of pipe rack shall be maintained all over as 8.0m.
 - vi) The pipes including fire water pipes shall be routed over ground either on pedestals or on pipe rack/trestle in the plant area. Trenches for pipes shall be avoided as far as possible.
 - vii) Wherever fuel oil pipes and steam pipes are running over the trestle, fire water pipes shall avoided to be routed on the same trestle.
 - viii) Headroom below cable/pipe rack in transformer yard area for movement of spare GT shall be such that the same can be moved with bushings installed. A clear gap of 500mm between top of bushing and bottom of structure (BoS) shall be ensured.
 - ix) A walkway of 800mm width (minimum) with hand rails and toe guards shall be provided all along length of the trestle for maintenance of cables and pipes. Ladders for approach to these platforms shall be provided near roads, passage ways. Gratings shall be provided for all external walkways.
 - x) Wherever ash pipes are routed on the trestle, it shall be routed on a separate tier and separate walkway shall be provided for the same. Clear head room of minimum 2.1m shall be provided for such walkways.
 - xi) The layout of shall be developed so as to meet the requirements of the cabling philosophy of the plant.
 - xii) Number of bends/change in direction shall be avoided as far as possible.
 - xiii) Trestles shall not foul with other structure.
 - xiv) Wherever trestles are adjacent to any building it shall not obstruct any windows, doors or other openings (other than those meant for pipes/cables) and any other connecting structures like platforms/stairs etc.
 - xv) Separate cable tray for optical fibre cable / UTP cable shall be provided.
 - xvi) Maximum cantilever allowed to route pipes and cables is 1.5m.
 - xvii) All pipes (50NB and above) should be supported on the structure; pipes hanging from structure on U-clamps shall not be permitted.
- 9.02.40 OTHER PLANT AREA AND GENERAL REQUIREMENTS
- i) All control rooms, electrical switchgear rooms, pump houses and any other functionally required buildings for the package is in bidder's scope.
 - ii) Cable trenches are not allowed in these buildings. All panels and switchgears should be kept at 1st floor, above cable floor which will be at the ground level.
 - iii) Remote I/O (RIO) rooms shall be provided as required. The exact RIO locations shall be finalised during detailed engineering.
 - iv) Control rooms/control equipment/RIO rooms shall be air conditioned.
 - v) Batteries for uninterrupted power supply systems as required shall be placed in a separate ventilated room.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- vi) The Cooling Tower (CT) and CW/ACW pumps shall be suitably located considering buried cooling water conduits to and from the power blocks and the CT make-up water piping. CW pumps shall be located in the CW pump house & cooling water from the CT will enter the CW sump through channel and a fore bay.
- vii) ACW booster pump house shall be suitably located near the 'A' row side of the PHB to optimise piping layouts.
- viii) The emergency DG sets shall be located suitable in a separate building, preferably near to the emergency bus.
- ix) The interconnection pipe work between plant utilities and power block equipment shall be routed through pipe racks/sleepers. Pipe trenches or buried pipes shall be avoided. The CW/ACW water conduits shall be laid below ground and buried.
- x) Adequate space as required by the Owner for operator's rest room, tool room and pantries shall be included in all buildings/operating area. Separate wash rooms, for ladies and gents shall be provided in all auxiliary buildings.
- xi) All pumps shall be located in covered building. Proper ventilation shall be provided. All pumps other than the pit/sump pumps shall be located above ground, except submersible pumps.
- xii) Ash slurry pipeline shall be routed on pedestals except at road/rail crossings where pipe racks/culverts shall be provided.
- xiii) Fabrication yard and laydown area shall also be developed as green belt.
- xiv) All oil pits and floor wash pit shall be provided with cover slab.
- xv) All pits shall have opening of minimum 1m x 1m with necessary vertical ladder for pit maintenance.
- xvi) All cable and pipe trenches shall be designed for easy maintenance.
- xvii) All cable trenches shall have suitable slope towards and end and a sump shall be provided for submersible pump.

9.02.41 HAZARDOUS AREAS

- i) The bidder shall take full account of any special requirements concerning the nature, handling and storage of all fuel oils, and chemicals etc., and provide plant, equipment, buildings and other services accordingly, including all facilities to ensure the safety of the operating and maintenance personnel.
- ii) The bidder shall provide drawings to define all the hazardous zones taking account of all sources of hazards under normal and abnormal operating conditions, (regardless of whether or not these areas are specifically listed in the specification).The zoning philosophy shall be subject to the approval of the Owner / Engineer.
- iii) In particular, equipment directly concerned with plant which may give rise to a hazardous situation shall be designed to requirements with electrical connection safety barriers or intrinsically safe equipment. Where required by the Owner / Engineer, certification shall be provided to confirm the suitability of the equipment and devices.



- iv) The Bidder shall be responsible for ensuring that all electrical equipment installed in any hazardous zone is designed and tested to suit the relevant zone classification and shall be to the approval of the Owner. Cables shall not be laid in trenches with fuel pipe work.

9.02.42 FIRE PROTECTION PROVISIONS

Unless otherwise specified or agreed with the Owner, the following design principles should be observed as minimum fire prevention requirements:

- i) Pipeline insulation and the infills of cable and pipeline wall penetrations are to be of non- combustible material.
- ii) All pipelines or vessels with internal temperatures of more than 180°C shall be so arranged as to avoid any contact with flammable liquids if fuel or lube oil lines should leak. Sufficient physical separation shall be ensured.
- iii) Particular care should be taken to eliminate any risk of hot pipeline-insulating material becoming impregnated with flammable liquids in the case of fuel or lube oil line leakage. The insulation is to be covered in its entirety, with an oil resistant sheet, over which the cladding is to be fitted.
- iv) Cable and pipeline ducts must be so arranged and sealed as to avoid any risk of flooding with, lube oil or any other flammable liquid. In addition to sealing the cable and pipeline ducts, the cable basements must be completely sealed against leakage from above as well, in order to preclude the ingress of lube oil or other flammable liquids.
- v) Covered floor ducts/trenches must be easily accessible for inspection and cleaning.
- vi) All parts of plant and equipment are to be arranged so that, no corners or pits are formed, in which flammable matter could collect, and would be difficult to inspect and clean.
- vii) Fuel preheating temperatures should be limited to a margin of at least 10°K below the fuel flash point.
- viii) Lubricating oil lines in the turbine-generator lube oil system are not to be connected with compression-type joints but rather with welded or screwed-type points.
- ix) Non-combustible materials which do not release noxious or toxic fumes must be used for wall and ceiling panelling, for floor covering, and for cubicles and cabinets.

10.00.00 ERECTION, SITE TESTING, COMMISSIONING AND RELIABILITY TEST

10.01.00 This section generally covers the minimum requirements of installation, testing and commissioning of various equipments, to be adhered to during the execution of the mechanical, electrical & instrumentation works.

10.02.00 Works shall be performed in accordance with this technical specification and various other drawings and schedules submitted and approved by the Owner during the execution and the instructions from Engineer-in-charge or his authorized representatives during the progress of the work.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 10.03.00 All consumables required for the job shall be ensured by the bidder.
- 10.04.00 Electrical power for testing, commissioning, reliability test and performance guarantee test shall be availed from start-up power (400kV/220kV grid) at free of cost.
- 10.05.00 All necessary equipments& instruments required to carry out the works, recalibration of the instruments required during loop checking and commissioning shall be done by the bidder.
- 10.06.00 Field quality plans shall be submitted and shall detail out for all the equipments, the quality practices and procedure etc. to be followed by the bidder's site quality control organization during various stages of site activities including receipt of materials/equipments at site, preservation and storage, pre-assembly, erection, pre- commissioning and commissioning.
- 10.07.00 All inspections and tests shall be done as per approved field quality plans and protocols.
- 10.08.00 The Bidder shall provide all necessary means for execution of inspection and testing, according to the requirements.
- 10.09.00 All critical equipments/spares/parts shall be stored in such a manner that weather effect shall not deteriorate the quality of material.
- 10.10.00 The consumables (oil, filters, glands, bearings, etc) & equipments needs to be changed after acceptance of successful completion of COD shall be provided/replaced by the bidder. Also, during conductance of PG Test if it deemed to replace/provide the consumables &equipment, it is also in the scope of bidder.
- 10.11.00 Erection**
- 10.11.01 Erection work shall be carried out in the manner and sequence as agreed with bidder's site in-charge/resident engineer and the Owner/Engineer.
- 10.11.02 Construction and erection shall be planned such that all below ground construction & erection shall be completed first, preferably before rainy season.
- 10.11.03 All existing structures, piping, conduits, equipment and facilities, if any, shall be protected by the Bidder against damage during erection. Any damage caused by Bidder shall be rectified at his cost to the satisfaction of the Owner.
- 10.11.04 As erection proceeds each assembled part before being boxed up with a view to erecting it finally, shall be inspected and approved by the concerned supervisor. If any defect is found out during such inspection, the bidder shall make it good as per directives from owner.
- 10.11.05 All materials such as electrodes, gaskets, bolts, nuts etc., shall be of reputed make and conforming to relevant Indian Standards. Prior approval of Owner will have to be obtained before commencement of work. Manufacturer's test certificate shall have to be provided when called for. The electrodes shall be of Diffusion, Bohler, D&H, Metrode make.
- 10.11.06 Bidder shall furnish all instruments, isotopes, films etc. for conducting radiography and equip himself fully. Necessary operators of all testing equipment shall be provided by the Bidder. Dark room facilities with air conditioners for

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

storing and processing radiography films and equipment, as necessary, shall have to be arranged by the Bidder. The radiography shall be done on any weld (including welds for repair) only after final heat treatment.

- 10.11.07 The equipment shall be placed on respective support, levelled and aligned with precision measuring instruments, checked for proper clearance between moving and stationary parts wherever applicable.
- 10.11.08 The installation of motors shall be carried out along with driven equipment in accordance with manufacturer's instructions and/or as directed by the Owner.
- 10.11.09 Wherever the scope includes control panels, all connections in control panels shall be completed, checked and adjusted to ensure safety and satisfactory operation of the equipment.
- 10.11.10 Particular attention shall be given towards removal of buckles and other forms of distortion. Holes in plate work to assist in erection should be avoided.
- 10.11.11 Misalignment in vertical joints shall not exceed 10% of plate thickness or 1.0 mm, or whichever is larger.
- 10.11.12 Misalignment in horizontal joints shall not exceed 15% of upper plate thickness with a maximum of 2 mm for plate thickness above 8 mm and a maximum of 1.0 mm for plate thickness less than 8 mm.
- 10.11.13 Welding sequence shall be adopted in such a way so as to minimise distortion due to weld shrinkage and shall be got approved from the Owner prior to commencement of work.
- 10.11.14 Welding shall not be carried out on wet surfaces and shall be protected from high winds.
- 10.11.15 **ERECTION PROGRAM AND NOTIFICATION**
- i) The Bidder shall furnish a detailed erection programme taking into consideration the constraints likely to be encountered during various phases of work including interfacing with the existing plant. This erection programme shall be strictly adhered to. The Bidder shall take appropriate steps as directed by the Owner to make up for any slippage from this erection programme and no additional compensation shall be allowed on this account.
 - ii) Before erection commences and not later than three months before start of erection, the Bidder shall submit the proposed erection test program and the commissioning test program with all proposed erection and commissioning tests and checks. Together with the test programs the proposed test procedures have to be submitted.
 - iii) The test programs should consider:
 - a) that the sequence and duration of the proposed activities are logical, realistic and in accordance with safety and permit regulations in force
 - b) that the commissioning of any item of plant would not interrupt the normal operation of the existing plant.
 - c) that allowance for training the Owner's operation personnel during this period has been made.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

iv) The Bidder has to take care that the test programs are maintained by the erection organization during erection and commissioning.

v) The Bidder has to mark all stages, which are subject to the Owner's acceptance and has to notify at least one (1) week in advance when such inspection for acceptance becomes due.

10.11.16 SUPERVISION DURING ERECTION

i) The Bidder shall provide at proper time the necessary supervisory engineers, supervisors and other supervisory personnel duly qualified and in sufficient number for transportation, handling, unloading, storage, erection, pre-commissioning and post commissioning etc., start-up, testing and trial operation of plants and equipment.

ii) The Bidder shall keep a competent representative, who shall be approved by owner, who will be resident Engineer-in-charge and shall remain as In-charge of Bidder's work site and also remain answerable to the Owner for all activities of the Bidder at site. Before his placement at site, the Bidder shall submit his bio-data to the Owner for his approval.

iii) The resident Engineer-in-charge shall supervise the work of all men of the Bidder working at site. He shall work in complete harmony and co-operation with Owner.

iv) All statutory rules and labour laws prevailing in the area must be followed by the Bidder.

v) All the areas shall be maintained clean and organised, both during execution and handover.

vi) All safety measures against occurrence of accidents must be taken effectively.

vii) Resident Engineer-in-charge shall not be withdrawn without written permission of the Owner.

viii) If any of the Bidder's personnel was found unsuitable for the job, the Bidder shall remove him forthwith and a suitable replacement shall be posted to site within a reasonable time. No compensation for withdrawing of unsuitable or unqualified person(s) from site or for posting suitable person(s) to site at any stage of the project shall be allowed by the Owner.

10.11.17 SEQUENCE OF ERECTION WORK

i) All packing cases and packages shall be opened in presence of the Owner or his authorized representative.

ii) Each material after stripping from boxes or received loose, shall be carefully inspected, checked with shipping list and identified with erection drawing if necessary. Any short supply and/or damaged part shall be reported forthwith to the Owner in writing. The Bidder shall be completely responsible to make all necessary arrangements, application and follow procedure to process claim on underwriters, obtain replacement repair/rectify and modify as required on all such damaged/defective/lost equipment and material at no extra cost to the Owner in order to execute the work to satisfaction of the Owner within the stipulated contract time. Once the materials are inspected, the same shall be preserved properly and adequately protected from theft and deterioration or damage by



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

rain, storm, dust, water, tampering by casual visitors or workers. The Bidder shall prepare and maintain stores, ledgers and bin cards for all materials in his custody.

- iii) Carrying out all repairs to damages that might have suffered during transit and in subsequent storage and modifications and rectification work and replacement of all lost parts, are under the Bidder's scope.
- iv) Nails and packing strips should be pulled out with suitable appliances and kept separately in container and not thrown away at random. All timber of packing cases shall have to be sorted out and stored properly at a suitable place as directed by the Owner. From time to time packing materials, timber, nails and strips shall be delivered back to the Owner or otherwise disposed of as directed by the Owner.
- v) All timber and packing materials shall remain the property of the Owner.

10.11.18 INSPECTION

- i) After completion of erection and/or installations and before start-up the equipment and all its appurtenances shall be thoroughly cleaned and then, inspected in the presence of the Owner for correctness, soundness and completeness of installation and acceptability for start-up.
- ii) All works to be carried out by the Bidder shall be subject to inspection by the Owner as applicable. The work shall be carried out as per applicable specifications, codes of practice, drawings and instructions of Owner. The Bidder shall provide necessary facilities, instruments, personnel etc., for carrying out the inspection as above and shall comply with the instructions given.
- iii) A check list in triplicate will be furnished for the approval of Owner wherein all items to be checked and necessary instructions will be listed. Inspection and checking shall strictly follow this check list. On completion of the joint inspection and checking two (2) copies of the check list will have to be handed over to the Owner. The check lists after checking will have to be jointly signed by the Bidder's supervisor and the Owner to ensure that all inspection and checking have been properly carried out. However, such endorsement shall not relieve the Bidder from the responsibility in ensuring proper erection and cleaning.
- iv) During inspection all clearance, alignment and important measurements and adjustments as may be directed shall be noted by the Bidder for future reference and guidance. Two (2) copies of such notes shall be delivered to the Owner.
- v) All reports of radiographic examination in a format approved by the Owner shall be submitted to the Owner for his approval and records.
- vi) All critical equipment/spares/parts shall be stored in such a manner that weather effect shall not deteriorate the quality of material.

10.11.19 CLEANING

- i) The Bidder shall observe strict cleanliness throughout execution of the work till handover of the plant.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- ii) Bidder shall be in possession of vacuum cleaner for cleaning the internals of machinery under installation. They shall check that all the finished surfaces are greased and covered.
- iii) Before boxing up, the Bidder shall examine carefully to ensure that no foreign material, such as welding rod ends, welding beads, metal chips, rope, working tools, etc., has been left inside any equipment.
- iv) In the case of motors, the following procedure shall be observed:
 - a) Checking and cleaning of bearings and charging/filling of lubricants, wherever necessary.
 - b) Cleaning of core and winding, drying out and cornicing the winding and measurement of air gap for motor assembled at site.
- v) Wherever the scope includes control panels, all withdrawable components shall be taken out and internals shall be cleaned with vacuum cleaner.

10.12.00 Testing and commissioning**10.12.01 GENERAL**

- i) The Bidder upon completion of installation of equipments and systems shall conduct pre-commissioning and commissioning activities, to make the facilities ready for sustained safe, reliable and efficient operation.
- ii) The pre-commissioning and commissioning activities including checks, initial operation, trial run and Guarantee tests of the equipment furnished and installed by the Bidder, shall be responsibility of the Bidder.
- iii) All pre-commissioning/commissioning activities considered essential for such readiness of the facilities, including those mutually agreed and included in the Bidder's quality assurance program, as well as those indicated in clauses elsewhere in the technical specifications shall be performed by the Bidder.
- iv) It shall be the responsibility of the Contractor to provide all necessary temporary arrangements, connections, instrumentation and other devices required during start-up and initial operation of the equipment systems which are installed by him.
- v) The Bidder shall provide 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 Bidder's workmen required for the above test shall always be present at Site during such operations.
- vi) The Bidder 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 Bidder shall be also be responsible for supplying such flushing oil and other lubricants unless specified otherwise, elsewhere in these specifications.
- vii) Bidder shall make all arrangements to conduct the commissioning and testing safely and all safety precautions shall be taken appropriately.



- viii) Wastes and effluents generated during these activities shall be suitably disposed off after neutralisation and meeting all statutory requirements, in a manner acceptable to owner and PCB.

10.12.02 TESTING & COMMISSIONING PROCEDURES

- i) Bidder shall prepare and submit equipment/system wise testing and commission procedures, for all equipment/system covered under the contract.
- ii) Commissioning and Testing procedures shall be submitted at least six (6) months prior to actual commissioning/testing; and bidder should ensure that all procedures should be approved by Owner, prior to actual commissioning/testing of the equipment/systems.
- iii) The Bidder shall furnish his recommendations regarding use of various test equipments and instruments and termination/acceptance criteria for testing & commissioning, which in any case shall meet the plant requirements.
- iv) Standard formats for Testing/commissioning procedure are expected to maintain consistency of presentation, content and reporting.
- v) The procedures should contain the following as a minimum:
 - a) Equipment/System details
 - b) Design data
 - c) Objective
 - d) Pre-requisites and readiness of associated items
 - e) Proposal – Method and Sequence of Activities (SoA)
 - f) Time duration of each activity
 - g) Inputs & Consumables required – Quantity and quality
 - h) Specification of temporary arrangements, as required
 - i) Safety precautions
 - j) Emergency procedures
 - k) Schemes and drawings, wherever required.
 - l) Completion/Acceptance criteria
 - m) Reference drawings/documents
 - n) OEM approval/acceptance for certain items like valves / control-valves to be included in the commissioning activities, like Steam Blowing.
 - o) Activity Log and commissioning protocol.
- vi) Commissioning procedures should include all pre-commissioning activities.

10.12.03 PRE-COMMISSIONING AND INITIAL TRIAL

- i) On completion of erection of equipment, each item of the equipment shall be thoroughly cleaned by Bidder and inspected jointly by the Owner/Consultant and Bidder for correctness and completeness of installation and acceptability for initial trials of the equipment by the Bidder& Owner. During the above joint walk



down, the list of equipment deficiency & defects shall be prepared and for such a punch list, action shall be initiated by the bidder in agreed time frame.

- ii) The list of tests to be performed prior to initial trials shall be mutually agreed and included in the Field Quality Plan by Bidder.
- iii) The purpose of these initial trials is to ensure integrity of all individual equipment for its operation in the system for initial operation.
- iv) Following the satisfactory completion of inspection, checking and cleaning of a unit, the plant will be placed in test run. During this period, all adjustments and repairs as required shall be made by the Bidder. Protocol shall be made and signature has to be obtained from Owner/ Bidder. On completion of satisfactory test run, the plant will be placed under trial operation.
- v) Prior to initial trial of any equipment the following shall be checked:
 - a) During erection all required erection tests as well as final erection checks of the mechanical completion of the systems and part thereof have to be performed.
 - b) After successful mechanical completion Mechanical Completion Certificates will be issued.
 - c) The activities necessary for mechanical completion shall include but not be limited to following testing, as applicable:
 - 1) Visual inspection after unloading at site
 - 2) Checking of completion of relevant systems
 - 3) Proper installation of the equipment and drive where applicable (like for rotating equipment), on the foundation
 - 4) Proper alignment of the equipment and drive where applicable (like for rotating equipment).
 - 5) Freeness of the rotors of drive and rotating equipment.
 - 6) Proper connection of supports, hangers, piping, valves, instruments and other fittings.
 - 7) Healthiness of lube oil system, changing and filling as necessary.
 - 8) Safety audit
 - 9) Testing of site welds (non-destructive examinations)
 - 10) Pressure/leak/tightness test
 - 11) Pipe line and equipment flushing and cleaning
 - 12) Chemical protection of piping systems
 - 13) Checking of coating
 - 14) Testing of cranes and hoists
 - 15) Safety signs and warning signs
 - 16) Completion of buildings and civil works



17) Test of ventilating and air-conditioning units

10.12.04 PRE-COMMISSIONING TESTING

- i) After installation of all equipment on foundation, alignment tests shall be carried out by the Bidder to check levelling, clearance, eccentricity etc. Measurements will be witnessed and acceptance will be certified by the Owner and/or owner's representative.
- ii) Preconditions for the commissioning are the issue of the Mechanical Completion Certificate and the availability of the accepted commissioning program and the bidder's commissioning procedures.
- iii) Hydro Test, Air & Gas Tightness Test and vacuum tightness test shall be conducted, as applicable, for the entire system/equipment after installation at required pressure. All necessary blanking and spool arrangements for hydro testing shall be furnished by the Bidder. All necessary test pump/temporary piping/temporary tanks etc shall be supplied by the Bidder. On completion of hydraulic test, bidder shall renew the gaskets, if instructed by the engineer.
- iv) Flushing of piping, including oil flushing of control oil system, lube oil system of all rotating equipment and oil flushing of fuel oil system.
- v) Steam blowing & chemical cleaning, as applicable of integral piping of the turbo-generator, piping of auxiliaries like BFP, CEP, Drip pump, interconnecting piping of feed water heating system, Low pressure piping, Power cycle piping & other piping in the scope of the Bidder shall be done.
- vi) The Pre-commissioning checks cover the functional tests of the individual items and their alarm and tripping systems.
- vii) Following general tests shall be included:
 - a) Mechanical equipment
 - 1) Individual pre-commissioning runs/initial trials of all rotating equipment such as pumps, compressors, dosing equipment etc.
 - 2) Functional tests of the mechanical equipment
 - 3) Testing and adjustment of safety devices.
 - 4) Fill test of tanks.
 - 5) All tests and activities pertaining to the heater exchangers as per OEM recommendations and this specification.
 - 6) All test and activities pertaining to auxiliaries like BFP, CEP, Drip Pumps, etc.
 - b) Hydraulic Testing of Pressure Parts – Boiler
 - 1) On completion of installation and all welding of the Steam Generator pressure parts and boiler external (non-boiler) high pressure piping, a hydraulic test according to the requirements of the Indian Boiler regulations (IBR) shall be performed by the Bidder.
 - 2) Hydraulic cap / blanking arrangement shall be employed wherever required, especially when valves/control valves supplied by others is

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

installed on the bidder's piping system, during hydraulic testing, and otherwise it should be subject to acceptance of respective valve supplier.

- 3) The water for hydraulic test shall be made alkaline by addition of suitable chemicals.
 - 4) After the test, the Boiler and high pressure external piping shall be suitably drained and preserved.
 - 5) Any defect noticed during the testing shall be rectified and the unit shall be retested by the Bidder, at the earliest.
 - 6) In case, the branch connection or tap-off piping, which is not in the Bidder's scope of piping, are not ready or not erected at the time of hydraulic testing of piping in Bidder's scope, then the Bidder has to supply and use necessary blanking arrangement as required at these locations.
 - 7) The hydraulic test shall be considered officially successful only on certification by the concerned inspecting authority as per the provision of the IBR and the Owner.
- c) Hydraulic Test for STG integral piping, heat exchangers, condenser tubes & condenser, equipment cooling water system pipes and associated equipment etc. shall be done.
- d) The hydraulic test of other piping system as per statutory requirement and specified elsewhere shall also be carried out.
- e) Air and Gas Tightness Test of Furnace, Ducts etc.
- 1) After completion of the installation of the furnace tubes and/or inner skin casing wherever applicable, on ducts and air heaters and before commencement of application of insulation, a test shall be performed on the steam generator and ducts, by the Bidder to prove and establish the gas tightness of erected components.
 - 2) The gas tightness shall include all the components in the Air-Gas path, from the outlet of FD fan, through Steam Generator, ESP, FGD, up to the Stack.
 - 3) Such tests shall be established, with all mountings like soot blowers etc. installed in position.
 - 4) Normally physical leak detection method by pressurising the section under test by running FD/PA fan or temporary blower, as the case may be, can be adopted. However, Bidder may adopt any other better method of testing, with the approval of owner.
 - 5) The air & gas tightness test, can be conducted on ducts in segmented manner, as and when these segments are ready.
 - 6) Temporary blanking wherever required has to be provided by Bidder.
- f) Boiler Chemical Cleaning



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 1) Bidder shall perform thorough and efficient cleaning of all the internal parts of the Steam Generator, like economiser, water wall / evaporator, separator, feed water piping, start-up recirculation lines and associated piping covered under these specifications, except those portions, which are to be steam blown.
- 2) The cleaning operation will include-
 - De-mineralised (DM) water flushing
 - Chemical cleaning using acids
 - DM water rinsing
 - DM water flushing
 - Nitrogen capping etc.
- 3) The cleaning procedure shall include final flushing and draining of the boiler under a nitrogen gas cap and/or filling the boiler with inhibited water or any other proven procedure recommended by the manufacturer for the preservation of the boiler which is acceptable to the Owner.
- 4) Dry preservation of non-drainable portion during shutdown has to be provided.
- 5) Chemical cleaning of equipment and piping systems
 - Following piping system, should be included:
 - ♦ Boiler feed pump discharge piping
 - ♦ Main condensate piping
 - ♦ Extraction steam piping
 - ♦ Other miscellaneous piping
- 6) The following equipments which form a part of the above system shall also be included in the cleaning operation.
 - Deaerator
 - Gland steam condenser
 - Drain cooler
- 7) Before introducing chemicals, all the piping systems and equipment listed above shall be water flushed. Water flushing will be followed by alkaline cleaning, acid cleaning and passivation or by EDTA (Ethylene Diamene Tetra Acid) and passivation.
- 8) Pre-cleaning procedure
 - Prior to starting any phase of cleaning operation the following procedures shall be ensured:
 - ♦ Installation of all temporary piping, valves, pumps and equipments as required for the flushing and chemical cleaning



operations. Temporary piping shall be routed at floor level as far as possible and secured in place to prevent movement/vibration beyond acceptable limits.

- ◆ Installation of the instruments as required for ensuring satisfactory monitoring and control of the cleaning process. The Bidder shall also determine and arrange locations for sampling of the cleaning solution during cleaning.
- ◆ By passing all regulation/control valves coming in the cleaning circuit or installation of temporary spool pieces.
- ◆ Installation of special end covers and temporary suction strainers, for boiler feed pumps and condensate pumps. pump internals shall not be installed.
- ◆ Installation of plastic seal in the condenser neck to protect the turbine from alkaline fumes. Blocking and securing of all spring hangers in the steam lines which may be flooded during the cleaning operation.
- ◆ Hand cleaning of the interiors of all vessels which are included in the cleaning operation.

9) General cleaning procedures:

- Seal water lines to pump shall be flushed by the permanent arrangement provided for the same.
- Where pipeline terminate in spray headers, these headers shall be inspected after each phase of the cleaning operation and cleaned if necessary.
- All strainers shall be observed closely during the cleaning operation by reading differential pressure gauges, and shall be cleaned when the differential pressure exceeds a predetermined value.
- All high points, vents shall be opened periodically to ensure full system flow.
- Upon completion of each stage of cleaning, the waste products shall be drained and transferred to the waste treatment basins. The Bidder shall then supply and add the necessary chemicals to the basin to neutralize all waste solutions and rinses generated by the cleaning process, and arrange for its disposal to an area to be indicated by the Owner/Engineer.
- Strict safety precautions shall be exercised at all times during the chemical cleaning and during storage and handling of the chemicals. The Bidder shall ensure provision of all protective clothing, apparatus and equipment along with necessary first aid kits as required for handling the chemical and for carrying out the cleaning operation.



g) Steam blowing

- 1) Steam blowing of Boiler including, complete Superheaters, Reheaters and various external and interconnecting steam piping system shall be carried out by the Bidder, as per the agreed/approved procedure.
- 2) Steam blowing shall include engineering, supply and installation of all temporary piping, valves, fittings including quick actuating valves (for puffing purposes), supports, blanking plates, spools, target plates, instruments, controls and all other accessories and services required to complete the cleaning process as specified herein.
- 3) The detailed schemes and procedure for steam blowing operations shall be prepared and furnished by the bidder and discussed and finalized during the detailed engineering stage.
- 4) Steam blowing shall also include reinstatement of cleaned piping systems; and dismantling/removal of all temporary piping, equipment and materials from site. All temporary piping, valves, equipment and materials shall be taken back by the bidder upon satisfactory completion of cleaning, and shall be removed from the Owner's premises.
- 5) Engineering involved regarding temporary piping shall include the following:
 - Selection of temporary piping including disturbance factor calculation.
 - Preparation of layout of temporary piping and performing stress analysis as per ANSI B 31.1.
 - Selection of temporary hangers and supports as required.
- 6) The following piping systems shall be cleaned through steam blowing operation:
 - Main steam, HRH, CRH, HP bypass & LP bypass piping
 - Auxiliary steam piping including TG gland sealing lines.
- 7) Steam blowing shall be carried out for removal of particles (rust, scales, weld splatter etc.) from various piping systems to avoid damage to turbine balding. Cleanliness of system shall be checked by means of test plates made of steel, which will be installed in the centre line of the piping system.
- 8) Cleaning shall be achieved by steam purging i.e. by blowing of steam through the piping such that the momentum of flow is greater than that of steam flow during normal operation of unit (at TMCR). The disturbance factor during steam blowing (ratio of momentum of flow during purge to that during TMCR) shall be more than 1.4
- 9) The blow off shall be done with steam, which is exhausted through adequately sized, open-ended temporary piping. Temporary piping



and motor operated valves shall be installed for steam blowing operation. Pressure shall be built up in the boiler and the piping warmed before release of steam by quick opening of motor operated valve located on temporary piping. The cycle shall be repeated until steam from the blow out pipe is determined to be clean.

- 10) OEM's acceptance for Valves/control valves which are to be kept installed in steam blowing circuit, should be furnished for owner's approval, before steam blowing; otherwise they will have to be removed during steam blowing. These acceptances should be included along with the procedure.
- 11) For equipments/components installed on high pressure external piping, such as various thermo-wells, flow meter, control valves, HP/LP Bypass valves etc., the Bidder shall comply with guidelines to be followed during steam blowing, with respect to removal / blanking / replacement of such items their internals etc. by spool pieces as given by the respective manufacturer/sub-contractor.
- 12) The actuator operated valves used for steam blowing shall have special characteristics like minimum loss of pressure, resistance to wear during severe working conditions (high velocity and carryover of water and solid particles), quick opening time, minimum effort on actuator etc.
- 13) If the flow nozzles and control valves etc. have already been erected these shall be removed and replaced by spool pieces before steam blowing. The removed flow nozzle and control valves etc. shall be put back after steam blowing.
- 14) In the case of branch connections/ tap-off piping are not ready or not erected at the time of steam blowing operation then the contractor to supply/use necessary blanking arrangements required at these tap-off / branch connections.
- 15) It will be the responsibility of the Bidder to operate the Steam Generator and its accessories equipment to generate adequate steam at the parameter and quality in line with the requirements of steam blowing procedure.
- 16) The Bidder shall make adequate provisions for temporary enhancement of fuel oil firing capacity of the steam generators by changing oil gun tips etc. as may be required so as to be able to conduct complete steam blowing operation by oil firing alone.
- 17) All necessary precautions to avoid fires and cold end corrosion of Air pre-heater, during such oil firing at enhanced SG loads, shall be taken by the Bidder.
- 18) For the steam blowing operation, steam conditions like pressure, temperature etc. at the Steam Generator outlet shall be so selected that a minimum cleaning ratio/ disturbance factor of more than 1.3 is achieved.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 19) A cycle of heating, cooling and blowing/ purging, is to be repeated to ensure thorough cleaning of the interior of the pipes/ tubes etc.
 - 20) The final indication of cleanliness shall be demonstrated by purging through target plates positioned at the discharge point.
 - 21) The steam blowing termination criteria shall be, achievement as under:
 - Acceptable target plate condition
 - Measured disturbance factor (DF) more than 1.3.
 - 22) The required values to calculate actual DF will be measured at site. The criteria for acceptable target plate condition shall be finalised during detailed engineering.
- h) SCR System
- 1) Complete pre-commissioning work including tests of facilities such as pressure drop test of SCR system and all other tests as mutually agreed in the Bidder test procedure and field quality assurance program as well as those identified in the specification.
- i) ESP
- 1) Complete pre-commissioning work including tests of facilities such as air and gas tightness tests of ESP, pressure drop test of ESP, gas distribution test of ESPs etc. and all other tests as mutually agreed in the Bidders test procedure and field quality assurance program as well as those identified in the specification.
- j) FGD
- 1) Complete pre-commissioning work including tests of facilities such as air and gas tightness tests of FGD, pressure drop test of FGD etc. and all other tests as mutually agreed in the Bidders test procedure and field quality assurance program as well as those identified in the specification.
- k) Electrical equipment
- 1) All tests and activities pertaining to Generator and Excitation system and auxiliaries like Primary water system, Seal Oil system, gas system etc.
 - 2) The following checks and test measurements shall be made during erection and pre- commissioning (as appropriate) in accordance with agreed standards:
 - Screwed connections for correct assembly
 - Terminals and terminal connections for correct assembly;
 - Checking of earthing connections and testing of earthing resistances
 - Measurement of insulation values



- Fire proof partitioning
- Marking, inscription, provision of designation plates
- Voltage checks
- Polarity checks in the case of D.C. voltages
- Fuses, over current trips, short-circuit trips, time settings, relay settings
- Transformer oil levels
- Safety signs and warning signs
- Setting indicators, revertive (check-back) signals to the central control room etc.
- Checks on wiring and cabling for conformity with the constructional circuit-drawings and plans
- High-voltage tests
- Trip tests
- Functional test on equipment.
- Tests on the transformers
- During installation - checking of complete delivery, checking of core earthing and insulation of active part from tank, H.V. sample tests of transformer oil in accordance with IEC, or equivalent Standards.
- During the Tests on Commissioning - checking of satisfactory operation.
- Tests on the generator main busbar - Checking for perfect electrical and mechanical correctness and for the air-tightness of individual main connections system.
- Tests on the earthing and lightning protection system - Acceptance tests and measurements of the earthing installations in accordance with IEC or IS standards.
- Tests on the lighting system - Proof of the minimum new value of lighting densities, checking of correct operation both electrically and mechanically.

I) Control and instrumentation equipment

- 1) Site related test for Control & Instrumentation equipment and calibration tests of instrumentation loop checking, functional testing of control equipment, interlocks, protection inputs, etc. are covered under Volume III, Part – C, Detail Technical Specification for Control & Instrumentation.



10.12.05 COMMISSIONING

- i) A precondition of the commissioning is the successful completion of the pre-commissioning checks of all items of the whole system. Commissioning basically consists of
 - a) Commissioning Tests
 - b) Initial operation and trial operation which also includes in it a Reliability Run and followed by PPA tests.
- ii) Commissioning tests
 - a) Commissioning tests shall be performed in accordance with the procedure contained in the commissioning program approved by the Owner for individual equipment/system and as a plant. Commissioning test shall also include redundancy and automatic fall back by simulation of fault conditions
 - b) On completion of each commissioning activity to the satisfaction of the Owner/ Owner's Engineer, the commissioning schedule shall be signed and dated by the Bidder and countersigned by the Owner and Owner's Engineer.
 - c) Commissioning test and initial operation shall prove that the plant is prepared and adjusted to ensure the correct functioning of the individual components and of the complete plant.
 - d) After successful completion of the commissioning tests and initial operation "Authorization to Trial Operation" shall be signed.
 - e) The commissioning test shall cover at least demonstration and acceptance of following tests:
 - 1) Test run and Operation of Pumps, Blowers, Fans, Compressors and other rotating equipment.
 - 2) Capability of all drives
 - 3) Protection tests
 - 4) Interlock tests
 - 5) Tests on Control & Instrumentation (C&I) Equipments
 - 6) Calibration tests of orifice, flow nozzles, instruments and control equipment to the extent included in these specifications
 - 7) Operation of protection devices including the following as a minimum
 - Boiler protection
 - Steam turbine protection
 - Generator protection
 - Transformer protection
 - Auxiliaries protection
 - 8) Fire protection systems operation



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 9) Isolation procedures method of isolation of plant equipment for safe shut-down and maintenance procedures including as a minimum
- HV station and unit supplies
 - LV supplies
 - Protection systems/settings, in accordance with agreed design and the requirements of the transmission system
- 10) Cold Air Velocity Test (CAVT)
- A CAVT shall be conducted on each Steam Generator during commissioning before its initial operation to establish the average cold air velocity and the velocity distribution at minimum three predetermined sections (Owner's Choice) of steam generator.
 - The data obtained from the CAVT will be used to compute the actual flue gas velocities as well as their distribution at the test sections during actual operation by correlating the CAVT data with the test/computed data from Thermal Performance Test.
 - Should the CAVT results after this correlation with TPT data indicate actual localized high flue gas velocity zones/ mal-distribution of gas flow and/or flue gas laning, suitably designed stainless steel screens at required SG cross sections shall be provided by the Contractor to bring the deviation of the localized gas velocity within $\pm 20\%$ of average gas velocity specified.
 - Through this test the Contractor shall also demonstrate the compliance with the specification requirements regarding the maximum allowable flue gas velocities at various sections of the Steam Generator.
 - The Contractor shall submit a detailed CAVT report and the computations of actual velocities after correlating CAVT data with TPT data to the Owner for approval.
- 11) Starting with stand-by auxiliaries
- 12) Operation of all auxiliaries, including chemical dosing systems.
- 13) Check run on the Pulverised Fuel (P.F.) Mills including clean air flow test.
- 14) Checks on operation of all air heaters and adjustment of seals, if necessary when each heater is up to its working temperature.
- 15) Checks on operation of all soot blowers and retraction gear and the sequences control.
- 16) Checks on correct functioning of the Burner Management System (BMS).
- 17) Start-up tests
- 18) Commissioning tests and procedures as per agreed/approved procedure for all SG &TG auxiliaries and BoP items within the



Bidder's scope of work; including checks on operation of all individual control loops in the control system.

- 19) Checks on operation of all individual control loops in the turbine generator control system.
- 20) Checks on correct functioning of the Turbine Protection System (TPS), Turbine Supervisory Control System (TSCS) for main turbine, Automatic Turbine Run-up System (ATRS), Automatic Testing of Turbine (ATT).
- 21) Turbine bypass operation capability - Test for HP/LP bypass valves operation & their control system.
- 22) Test for operation of governing control system for turbines.
- 23) Condenser vacuum test, feed water heater operational tests for establishing correct cascaded flow, heater water levels etc. & checking of all parameters as per approved heat balance diagrams.
- 24) Verification of start up times and loading rates of power unit and steam generator at various downtime conditions
- 25) Normal automatic start to preset load
- 26) Staged automatic including start to synchronous speed, manual synchronizing (including synchro-check), automatic synchronizing, manual and automatic loading
- 27) Power unit(s), to test partial and full load rejection to demonstrate
- 28) Full load rejection tests to measure transient maximum speed and steady state speed at normal governor droop setting
- 29) Method of resynchronism to be demonstrated

10.12.06 INITIAL AND TRIAL OPERATION

- i) After successful completion of commissioning and Initial Trials of respective equipment and after relevant test protocols have been accepted by the Owner, the Bidder shall be allowed to prepare the Plant Unit for Initial Operation.
- ii) After successful Initial Trials of all the individual equipment, all equipment shall be operated together as a system. The purpose of this Initial Operation is to ensure integrity of all the sub-systems which compose the total system. Based on the observations made during Initial Operation, necessary corrections shall be effected in the equipment/systems to ensure proper integrated operation of the system.
- iii) During Initial Operation, any adjustments/calibrations to the instruments fitted in the new system shall be done in the presence of testing staff of Owner so as to enable them to familiarise themselves with its adjustments and maintenance. The Bidder has also to ensure that he trains Owner's Engineers at site dealing with this system in proper way.
- iv) After satisfactory completion of Initial Operation for each sub-systems and systems, the complete Unit shall be considered ready for Trial Operation.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- v) During Trial Operation, the associated plant auxiliaries and Unit will be started up and loaded. During this loading operation all the controls and protections shall be finally set.
- vi) During the period of Trial Operation, all the necessary adjustments in the plant/equipment shall be made by the bidder to establish that the complete system as a whole with all sub-systems and with all standby equipment is ready for coordinated continuous operation. During these trials, all the standby equipment also shall be run alternatively to prove their performance.
- vii) After the plant is loaded to the maximum capability rating and the bidder is fully satisfied with its performance, he shall offer the unit for Reliability run by communicating the same to the Owner in writing. After receipt of such communication and if the owner/engineer is also satisfied with the initial operations, after approval from owner; the plant will be put on trial operation/reliability run.
- viii) During this period, the Bidder shall demonstrate capabilities of his supplied equipment as indicated in the specification or in subsequent discussions.
- ix) The trial operation/reliability run shall also demonstrate the following:
 - a) Performance of individual system during coordinated operation and their performance in design condition.
 - b) Unit Start-up
 - 1) Start-up time (upto full load), and loading capabilities for the Turbine Generator together for cold start conditions (greater than 36 hours shutdown), warm start conditions (between 8 and 36 hours shutdown) and hot start conditions (less than 8 hours shutdown) or as indicated by the Bidder in the offer and accepted by the Owner, shall be demonstrated, ensuring that the various turbine operational parameters like vibration, absolute and differential expansion, eccentricity and steam-metal temperature mismatch etc. are within design limits.
 - c) Unit start-up/shutdown demonstration as per combined start-up curves for cold, warm and hot conditions
 - d) Sustained capability of the plant
 - e) Reliability of the equipment and auxiliaries
 - f) Adequacy of the various auxiliaries, ancillaries & systems and controls.
 - g) Capability of all equipment & drives of the plant to correctly perform the functions, for which it is specified/designed, shall be demonstrated.
 - h) Safety requirements
 - i) Standby system availability
 - j) Operation of interlocks



- k) LP/HP bypass operation capabilities
- 1) The HP & LP Bypass system should satisfy the following functional requirements under automatic interlock action. It should come into operation automatically under the following conditions:
 - Generator circuit breaker opening
 - HP - IP stop valves closing due to turbine tripping
 - Sudden reduction in demand to house load
 - 2) It shall also be demonstrated that, under all these conditions, while passing the required steam flows as per the relevant heat balances, the condenser should be able to swallow the entire steam without increasing the exhaust hood temperature and condenser pressure beyond the maximum permissible value indicated by the Bidder in his offer and accepted by the Owner.
- l) SH/RH spray system
- m) SADC and its control
- n) Boiler Air & Gas System interlock operation
- o) Soot blower operation
- p) TG Set Capability
- 1) The steam turbine generator unit shall be capable of delivering at generator terminals the output as indicated by the Bidder in the heat balances submitted along with his bid, under the following condition.
 - 2) Maximum continuous output at generator terminals corresponding to both strings of HP heaters out of service, under rated steam conditions, at condenser pressure of 89 mmHg(Abs) and 1% make-up & Aux. Steam requirement tapped from CRH, generating not less than the rated output OR output corresponding to design BMCR heat duty, whichever is less without overstressing turbine components.
 - 3) While conducting the tests of (a) above the condenser pressure measurement shall be done at 300mm above the top row of condenser tubes .
- q) Condenser
- 1) Temperature of condensate, at outlet of condenser, shall not be less than saturation temperature corresponding to the condenser pressure at all loads.
 - 2) Oxygen content in condensate, at hot well outlet, shall not exceed 0.015 CC per litre over the entire load range and shall be determined according to calorimetric Indigo - Carmine method
 - 3) Air leakage in the condenser under full load condition shall not exceed more than 50% of design value taken for sizing the condenser air evacuation system.



- 4) When one half of the condenser is isolated, condenser shall be capable of taking at least 60% T.G. load under EMCR conditions.
- 5) The capacity of each vacuum pump in free dry air under standard conditions at a condenser pressure of 25.4 mm Hg (abs) and sub cooled to 4.17 deg.C below the temperature corresponding to absolute suction pressure shall not be less than specified elsewhere. Correction curves for establishing the capacity at site conditions shall also be furnished
- 6) Condenser on load tube cleaning system shall be made ready before trial operation of the plant. Life of sponge rubber balls & Number of balls lost during 720 hours of continuous operation of COLTCS shall be demonstrated by the bidder.
- r) Feed Water Heaters & Deaerator
 - 1) TTD's and DCA's of feed water heaters in line with 800 MW TMCR heat balance shall be demonstrated.
 - 2) Dissolved O₂ content in Deaerator effluent at deaerator outlet without chemical dosing at all loads, not to exceed 0.005 CC/ litre determined as per ASTM-D-5543-09 or Indigo Carmine method.
 - 3) Difference between saturation temperature of steam entering the deaerator and temperature of feed water leaving deaerator.
- s) Boiler Feed Pumps
 - 1) The vibration, noise level and parallel operation of any two of the three pumps shall be demonstrated as per specification requirements.
 - 2) Cold start up / hot start up of the unit using TDBFP with motive steam from auxiliary steam header.
- t) Condensate Extraction Pumps
 - 1) The vibration, noise level and parallel operation of any two of the three pumps shall be demonstrated.
- u) Drip pumps (if envisaged)
 - 1) The vibration and noise level shall be demonstrated.
- v) Balance pumps, Blowers, Fans, Compressors and other rotating equipment
 - 1) The vibration, noise level and parallel operation, wherever applicable, of the pumps, blowers, fans, compressors and rotating equipment shall be demonstrated.
 - 2) Pumps, blowers, fans, compressors and rotating equipment shall be capable of delivering flow and head corresponding to design point as specified
- w) Demonstration of boiler operation, rate of change of load and sudden load change withstand capability



- x) Sudden Total Loss of External Load
 - 1) On occasions, the steam turbine generator unit may experience sudden total loss of all external load. Under these conditions, the steam turbine generator unit shall not trip but shall continue to be in operation under the control of its speed governor to supply power for the plant auxiliary load with HP-LP bypass in operation while staying within the agreed limits of steam to metal temperature mismatch, exhaust hood temperature, absolute and differential expansion, vibration and eccentricity.
 - 2) The same shall be demonstrated. Further, the provisions of relevant Parts/Sections of the specification shall also be complied with.
- y) Steam Metal Temperature Mismatch Limitation
 - 1) The steam-metal temperature differential for cold, warm and hot start up, loading / unloading and shutdown conditions shall be within the permissible limits indicated by the Bidder in the offer and accepted by the Owner.
- z) Steam Temperature Imbalance
 - 1) The Contractor shall demonstrate that at SH and RH outlets (in case of more than one outlet) the temperature imbalance between the outlets does not exceed 10 deg C under all loads including transients.
- aa) Minimum continuous low load operation, without oil support, when firing with the coals from the range identified. The contractor shall demonstrate that with any combination of mills/adjacent mills in service (to Owner's choice) the Steam Generator does not require oil firing for stable boiler operation at the agreed load.
- bb) Operating stability when operated in the full range of load conditions with load variations by increasing or decreasing the electric load
- cc) Demonstration of the capabilities of the Power Unit to operate at rated voltage and frequency, at power factors and reactive conditions between 0.85 (lag) and 0.95 (lead) start-up tests of the Plant equipment, facilities and systems including checking of automatic change-over of standby facilities
- dd) Capabilities of firing of coal & 10% Biomass
 - 1) Bidder shall demonstrate the capability of Steam generator and its auxiliaries to operate at rated parameters stably, safely and on sustained basis at TMCR load while firing 10% Biomass, along with the range of Indian coals
 - 2) Duration of such test, to establish the Steam Generator co-firing capability, will be mutually agreed by Bidder and Owner.
- ee) Performance characteristic of fans (PA/FD/ID fan capacity, head developed, etc



- ff) Margin on equipment, especially fans
- 1) After completion of installation of fan drives, Fans, inlet and outlet ducting, measuring equipments etc. contractor shall demonstrate the margin on seal air fans, primary fans, Forced draft fans and induced draft fans as specified elsewhere in Technical Specifications.
 - 2) Similarly margin on other equipment as specified shall be demonstrated.
- gg) Balancing of Coal/Primary air flow
- 1) Bidder shall balance the primary air as well as coal flows in the pulverised fuel pipes such that the minimum PF and PA flow imbalance in the PF pipes from each coal pulveriser does not exceed 5% of average flows.
 - 2) The above balancing shall be checked by the Bidder by carrying out both clean air test and dirty air test (using dirty pitot tubes)
- hh) ESP
- 1) Contractor shall demonstrate that ESP air in leakage shall be limited to 1% of the total gas flow under guarantee point condition.
 - 2) Contractor shall demonstrate that the maximum flue gas pressure drop across the ESP under specified guarantee point condition shall not exceed 20 mmwc.
- ii) FGD
- 1) Capabilities of all drives & equipment
- jj) Fire Protection System
- 1) Vibration and noise of fire water pumps
 - 2) Parallel Operation, vibration & noise level of the fire water pumps and diesel engines.
 - 3) Performance test of each of systems such as, as per the design parameters/standards/TAC –
 - Hydrant,
 - HVW Spray,
 - MVW Spray,
 - Foam Injection system,
 - Inert gas extinguishing system,
 - fire detection and alarm system,
 - Fire monitors
 - Fire extinguishers
 - 4) All tests as required by the TAC.



- kk) Satisfactory operation of the Mill Reject Handling System as per the requirements of the specification.
- ll) Satisfactory operation of Coal and Biomass handling plant as per the requirement of the specification
- mm) Satisfactory operation of Ash handling plant as per the requirement of the specification
- nn) Satisfactory operation of Lime and Gypsum handling plant as per the requirement of the specification
- oo) Satisfactory operation of compressed air system as per the requirement of the specification
- pp) Satisfactory operation of all Air conditioning and ventilation system per the requirement of the specification
- qq) Satisfactory operation of plant water system and cooling water system as per the requirement of the specification
- rr) Satisfactory operation of all other BOP (Balance of plant) systems as per the requirement of the specification
- ss) Satisfactory operation of the Auxiliary Steam and PRDS System as per the requirements of the specification.
- tt) Verification of vibration and noise emission guarantees
- uu) Environmental monitoring equipment, water quality monitoring equipment, functioning tests and verification of guarantees
- vv) Verification of active power response and voltage control response according to the requirements specified in the network connection conditions
- ww) Demonstration of proper controlling, monitoring and recording according to the requirements of the grid code
- xx) Verification of completeness of scope of supply
- yy) Verification of 24 hours uninterrupted MCR operation
- x) Owner will arrange necessary dispatch clearance (to export generated power to the grid) for initial and trial operation from Load dispatch centre
- xi) The Reliability run of the unit/plant shall be undertaken jointly with the Owner as a part of the trial operation and within the trial operation period.
- xii) The Reliability Run of the plant will be established and the Trail Operation Test shall be considered successful if, during the Trial Operation, the complete plant as an integral unit, shall be operated for minimum 720 continuous hours, on designated fuel, at prevailing ambient conditions, and achieves the following:
 - a) The plant should operate continuously on for minimum Fifteen (15) days uninterrupted at a load not less than 95% of the capacity of the plant; and
 - b) The plant should operate continuously minimum seventy two (72) hours at rated full load, in fully automatic mode i.e. with Coordinated Master Control



(CMC) on fully automatic mode. No interruption is allowed during this 72 hrs period; and

- c) During the 30 days (720 hrs) period of operation, the 800MW unit shall generate a minimum of 4896 million units (kWh) i.e. 85% of maximum possible generation at 100% TMCR, as measured at generator terminals.
- xiii) During the period of trial operation, the time of operation with any load shall be counted. Minor interruptions not exceeding thirty minutes at a time, caused during the continuous operation, shall not affect the total duration of trial operation.
- xiv) However, for longer interruption and any interruption due to defect in the equipment and sub-system or system, the owner may extend the duration of trial operation depending upon the period of interruption. In the event of interruptions to the reliability test run, for which the Bidder is responsible, the length of the reliability test run can be extended by a period equal to the total duration of the interruptions.
- xv) If such an interruption due to bidder lasts more than 24 hours, the reliability test run shall be restarted, after repairing the defect. The reliability test run may be interrupted due to bidder on a maximum of three occasions only.
- xvi) A trial operation report comprising of dates and duration of trial, observations and recordings of various parameters to be measured shall be prepared by the bidder and signed jointly by the owner and the bidder. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the trial operation. If the trial operation is established to be satisfactory, except for some minor adjustments, if any, the bidder shall prepare the plant for performance guarantee test.
- xvii) However, if the Trial Operation is not satisfactory, necessary modification/repairs to the plant/ equipment based on the observations during trial operation shall be carried out by the bidder and on completion of such works the trial operation shall be repeated again.
- xviii) The initial & trial operation shall be undertaken jointly with the owner.
- xix) After the trial operation is carried out successfully, to declare it as such, a joint protocol shall be signed among the Chief Engineer (O&M), GSECL, the Project Manager or their authorised representatives and the Bidder.
- xx) The fuel (primary and secondary) and start-up power for initial & trial operation, test/commissioning and PG Test shall be provided by the Owner.
- xxi) Moreover, for the Purpose of commissioning, trial operation and Guarantee Tests, the Owner shall provide operating personnel for operation of the equipment. Such personnel provided by the Owner shall work under the supervision of the Bidder till the Plant is taken over by the Owner.

11.00.00 PERFORMACE GUARANTEES AND ACCEPTANCE TESTS

- 11.01.00 The term "Performance Guarantees" wherever appears in the technical specification, shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever



appears in the technical specification, shall have the same meaning and shall be synonymous to "Guarantee/Acceptance Test(s)"; these terms may also have been used interchangeably.

- 11.02.00 All the equipment performance guarantee to be proven with connecting system
- 11.03.00 After satisfactory completion of the trial operation, and is established, the performance test shall be conducted at site by the bidder.
- 11.04.00 The bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in the specifications. The performance guarantee figures of the equipment/system shall be proved by the bidder during the performance guarantee test.
- 11.05.00 The bidder shall provide guaranteed performance for the complete package and the values guaranteed shall be binding on him.
- 11.06.00 The bidder shall conduct performance test as described in the contract document and prove the guarantees as per mutually agreed & approved procedures.
- 11.07.00 Performance guarantee shall be provided for operation at contract specific site reference conditions as specified and the guaranteed performance parameters of the plant shall be proved by the bidder during the test. Should the results of these tests show any deficiency from the guaranteed value, the Bidder shall modify the equipment as required at no extra cost, to enable it to meet the guarantee
- 11.08.00 The guaranteed performance parameters furnished by the bidder in his offer, shall be without any tolerance values whatsoever. All margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.
- 11.09.00 The Bidder shall conduct performance tests and demonstrate all the guarantees covered herein during performance guarantee/acceptance test (PG test). The various tests which are to be carried out during the PG test are mentioned in the specification.
- 11.10.00 The tests shall be conducted at the specified load conditions or as near the specified conditions as practicable. The owner/bidder will apply agreed factors to compensate for deviation from the designed parameters. The suitable correction curves mutually agreed by the owner and the bidder shall be used.
- 11.11.00 The parameters indicated under 'Correction' shall be guaranteed by the bidder during the performance tests and if the parameters are not attained during the performance tests, bidder shall make all efforts to achieve the parameters.
- 11.12.00 These tests shall be binding on both the owner and the bidder to determine performance of the equipment/system with the performance guarantees data.
- 11.13.00 The Bidder should make the plant ready for the PG tests before start of Trial Operation.
- 11.14.00 Once the Trial Operation starts, No further shutdown is envisaged for preparation of PG test. But, in case of an unavoidable situation, owner will provide required shutdown, on mutually agreed basis.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 11.15.00 In case any specific preparation is required to make the plant ready for this test shall be carried out by the bidder for which owner will provide required shutdown, on mutually agreed basis.
- 11.16.00 All Category-I Performance Tests shall be conducted along with the Trial Operation; except the following:
- 11.16.01 Coal Mill Wear Parts Warranty
- 11.16.02 PG Test of Cooling Tower (IDCT) shall be carried out by the Bidder within one (1) year of successful completion of initial operation of the cooling tower and at a time when the atmospheric condition are within limits of deviation from the design conditions as specified, preferably in the period from June to September. If plant initial operation falls in these months then PG test of IDCT can be clubbed with Unit initial operation.
- 11.16.03 PG test of AC System (especially for Auxiliary Power Consumption, under station auxiliaries) shall be carried out by the Bidder within One (1) year of successful completion of trial operation of the respective AC system during summer in the months of March to June.
- 11.17.00 It shall be responsibility of owner to arrange for start-up power, primary & secondary fuel, water and load dispatch clearance (to export power) during PG tests.
- 11.18.00 The performance tests shall be performed using only the normal number of operating staff provided by the owner. Bidder, vendor or other subcontractor personnel shall only guide wherever required and collect necessary data for compiling the reports.
- 11.19.00 At all times during the performance tests the emissions and effluents from the plant shall not exceed the guaranteed emission and effluent limits.
- 11.20.00 The duration of the Performance Guarantee Test of the plant at the rated capacity shall be mutually agreed. However, a stability period of 2 hours before commencement of test and 2 hours test period followed by another 2 hours stable period shall be maintained.
- 11.21.00 All efforts shall be made for successful completion of the PG test along with Trial Operation of the unit on designated fuel or as per the time frame specified for a particular equipment/ plant/ system in the Technical specifications. Delay in conductance of the test beyond this period will not be normally permitted by the owner. In the event of owner agreeing to conductance of such tests after three months, for reasons not attributable to the owner, as assessed by the owner, no factor for ageing shall be considered for computing performance of the equipment.
- 11.22.00 The guarantee tests shall be conducted by the bidder at site in presence of owner.
- 11.23.00 All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.
- 11.24.00 Any special equipment, tools and tackles required for the successful completion of the performance tests shall be provided by the Bidder free of cost.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

11.25.00 Performance Guarantee Tests on the equipments/systems not covered in this section shall be carried out as per the procedure/test codes specified in respective detailed section.

11.26.00 Measurements

11.26.01 All instruments including flow nozzles as necessary for conductance of PG tests shall be installed prior to the start of initial operation. No shutdown shall be allowed for installation of PG test instrument/ flow nozzle etc. Any advanced class instrument system such as those using electronic devices or mass flow technique shall be arranged by the contractor, if required. However, same shall be installed before start of initial operation of unit.

11.26.02 All test instrumentation as required for the Performance Guarantee Test shall be provided by the Bidder free of cost. Special / Precision instruments required for Performance Guarantee Test shall, however, be arranged by him and shall be returned to him after successful completion of the tests. All test instrumentation shall be in accordance with the applicable code.

11.26.03 All the necessary instruments (in duplicate) required for the tests shall be furnished by the bidder so as to meet the accuracies specified in the codes.

11.26.04 Any advanced class instrument system such as those using electronic devices or mass flow technique shall be arranged by the bidder, if required.

11.26.05 The essential mandatory requirements for instruments, methods and precautions to be employed shall be in accordance with the requirements specified in the respective codes.

11.26.06 Instruments for PG test and instruments for process control of similar applications are envisaged to be of same make and model having same accuracy level. However, instruments for PG tests are also acceptable as per standard and proven practice of the Bidder/OEM and in such case; instruments for process control shall be as per requirements of the specification.

11.26.07 All the instruments shall be calibrated by a certified body (an accredited independent test institute) before and after the tests Instruments need to be calibrated before and after the test to identify the drift which is to be used for applying corrections to the calibration which is estimated based on the average of the pre-test and post-test calibrations

11.26.08 All the instruments including the flow nozzle shall be calibrated by the contractor before initial operation in a reputed international institute. All calibrations reports shall be made available prior to the start of initial operation and calibration certificates in original submitted to Employer. All calibrations shall be made available prior to the test and calibration certificates in original submitted to Owner at least 15 days before conductance of the test for Owner's approval.

11.26.09 The calibration certificates shall be considered valid for a period of not more than six (6) months from the date of its calibration or as per the guidelines of NABL accredited Calibration agency.

11.26.10 The instruments shall be sealed after calibration by calibrating lab. The percentage calibration error/deviation should not be more than accuracy class of the instrument. Calibration low beta ratio throat tap nozzle assembly including



flow straightner, upstream and down stream machined straight lengths, for main condensate flow measurements shall be as per ASME PTC6.

- 11.26.11 All test instruments and calibration procedures shall be duly approved by the Owner. Batch calibration shall not be accepted. Calibration before and after test and installation of the test instrumentation for the test shall be the Bidder's responsibility.
- 11.26.12 Control system loop tuning required to limit the variation of parameters during performance guarantee testing shall be completed prior to Trial Operation / PG Test.
- 11.26.13 All PG test process parameters shall be made available in DCS.
- 11.26.14 The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.
- 11.26.15 Tools and tackles, thermo wells (both screwed and welded) 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; with all costs included in the contract price.
- 11.26.16 For determination of primary flow to the turbine, a calibrated low Beta-ratio throat-tap nozzle assembly shall be installed permanently in condensate line prior to initial operation; same shall be also used for process control.
- 11.26.17 Secondary flow devices shall be calibrated flow nozzle / orifice plate as per ASME PTC 19.5.

11.27.00 Test Documents

11.27.01 TEST PROCEDURE

- i) Bidder shall submit all PG test procedures, as per latest codes / standards, meeting the specification requirements, along with sample calculations and detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.
- ii) The test procedure shall highlight the anticipated date for the test, list of instruments and their accuracies, arrangement and form of the tests.
- iii) The procedure shall include the following for each test or group of tests:
 - a) Objective of the test
 - b) Prerequisites and system readiness checklist.
 - c) Safety and emergency precautions and preparations required; and checklist.
 - d) Various guaranteed parameters & tests as per contract.
 - e) Method of conductance of test and test code.
 - f) Duration of test, frequency of readings & number of test runs.
 - g) Method of performance calculation and formulae.
 - h) Correction calculations, curves and respective equations for graphs to be fed for the online computation.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- i) Instrument list consisting of range, accuracy, least count, and location of instruments.
- j) Scheme showing measuring points.
- k) Sample calculation
- l) Acceptance criteria.
- m) The sequence of the tests to be conducted.
- n) The time duration of each test
- o) The number of test runs
- p) A list of instruments that will be used for each test. The list shall define which instruments are:
 - 1) Special test instruments,
 - 2) Certified,
 - 3) To be calibrated before and after each test to identify the drift which is to be used for applying corrections to the calibration which is estimated based on the average of the pre-test and post-test calibrations,
 - 4) Check instruments,
 - 5) Station supply instruments
 - 6) Schematic diagram showing all test points and cross referenced to the instrument list and
 - 7) Method of data logging. Data logging thro' satellite communication is not permitted.
- q) All formulae, calculations, conversion factors, curves, correction curves etc., to be used in the conducting of the tests and the calculations of the test results. All such items shall be to a accuracy level of four decimals.
- r) Sample test reports to data sheets and all specific result sheet forms that will be used for the test.
- s) Special conditions if any.
- t) Any other information required for conducting the test and analysing the test results.
- iv) The provisions outlined in the ASME performance test code or other International and Indian approved equivalents shall generally be used as a guide for all the above test procedures unless specified otherwise in the specification.
- v) All tests shall be carried out and acceptance shall be according to mutually agreed procedures.

11.27.02 TEST REPORTS

- i) After the conductance of PG test, the test results shall be calculated in Bidder's PG test program/software. The correction curves shall be fed/inbuilt in the PG test program/software. Provision of manual entry of offline data, which cannot be



captured online (such as Relative Humidity, Atmospheric pressure, Coal Analysis, Un-burnt carbon in fly ash and bottom ash, Bottom ash / Fly ash collection in various hoppers, Flue gas analysis (grid result) etc.) shall be provided.

- ii) The Bidder shall prepare test reports for each performance test in which the methods followed, instrument readings, graphs, observations, final results obtained etc., shall be recorded.
 - iii) Evidence of the test data shall be issued by Bidder after who shall also perform the necessary calculations. The basic information and figures to be used for the tests shall be compiled by Bidder.
 - iv) The details of all measuring/recording meters, test instrumentation such as class of accuracy, make etc. shall be covered in the trial operation and performance test reports.
 - v) The reports shall contain a summary of any tests and certifications as well as results, recorder charts, observations and comments derived from the testing and turnover procedure as applicable.
 - vi) For each of the Performance & Guarantee Tests, the Bidder shall evaluate the test figures and compile the Test Report containing a complete analysis of the test results.
 - vii) Bidder shall examine and sign the reports and certificates of all tests. The Owner shall review and comment on all test protocol and procedures, reports and certificates.
 - viii) After the conductance of Performance test, the Bidder shall submit the detailed test evaluation report of Performance test results to Owner promptly but not later than two (2) weeks from the date of conductance of Performance test. Preliminary test reports shall be submitted to the Owner after completing each test run. Six (6) hard copies and soft copies as desired by owner, of each test report of final conducted test on each equipment/plant/system shall be submitted to Owner for approval.
- 11.28.00 The Bidder shall conduct performance test and demonstrate all the guarantees covered herein under Category I, II & III.
- 11.29.00 If, the results of these tests are at adverse side from guaranteed values, the Bidder shall modify the equipment as required to bring it to meet the guarantees. In such cases, the performance tests shall be repeated within one month from the date on which the equipment is made ready again for tests. All costs of modifications including labour, material and the cost of additional testing to prove that equipment meets the guarantee shall be borne by the Bidder.
- 11.30.00 If, the PG test fails i.e. the Functional Guarantees are not met, either in whole or in part, the Owner may, at its sole discretion, provide the Bidder notice, setting forth particulars of such defects or failure. The Bidder shall, forthwith upon receipt of such notice, at his own cost and expense, within reasonable period allowed by the owner, make such changes, modifications and/or additions to the Plant and Equipment or any component thereof, as may be necessary to meet the Functional Guarantees. The Bidder shall notify the Owner upon completion of the necessary replacement, changes, modifications and/or additions, shall



request the Owner to facilitate the repetition of the Guarantee Tests until the Functional Guarantees have been met.

11.31.00 If, the PG test fails i.e. the level of tested functional/performance guarantee parameters is beyond the acceptable shortfall limits, either in the whole or in part, even after the expiry of any additional time granted by the Owner (i.e. after carrying out necessary changes, modifications, and/or additions), the Owner may, at its sole discretion, exercise anyone of the following options:

11.31.01 FOR CATEGORY-I GUARANTEES – PERFORMANCE GUARANTEES UNDER LIQUIDATED DAMAGES

- i) Accept the equipment/system/plant after levying liquidated damages as specified in Volume - I, penalty shall be pro-rated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category-I' Guarantees

Or

- ii) Reject the equipment/system/plant and recover from the Bidder the payments already made.

11.31.02 FOR CATEGORY-II GUARANTEES – PERFORMANCE GUARANTEES UNDER REJECTION

- i) Reject the equipment/system/plant and recover from the Bidder the payments already made. Conformance to the performance requirements under Category-II is mandatory.

11.31.03 FOR CATEGORY-III GUARANTEES – PERFORMANCE GUARANTEES UNDER COMPULSORY CORRECTION.

- i) Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover amount equivalent to the damages as determined by the owner, from the contract price. Such damages shall, however be limited to the cost of replacement of the equipment(s) / system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as 'Category-III' Guarantees

Or

- ii) Reject the equipment/system/plant and recover from the bidder the payments already made.

11.32.00 Guarantees under Category – I (Performance Guarantees under liquidated damages) are as follows:

11.32.01 Unit Heat Rate at 100% TMCR Load

- i) This will be the Guaranteed Heat Rate in kcal/kWhr, under rated steam conditions at 77 mmHg(abs) condenser pressure, with zero make-up, at 800 MW load (i.e. 100% of rated load).

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

11.32.02 Unit Heat Rate at 55% TMCR Load

- i) This will be the Guaranteed Heat Rate in kcal/kWhr, under rated steam conditions at 77 mmHg(abs) condenser pressure, with zero make-up, at 440 MW load (i.e. 55% of rated load).

11.32.03 TG Output

- i) Continuous TG output of 840 MW unit load (i.e. 105% of rated load) under rated steam conditions at 77 mm Hg (abs) condenser pressure, with zero make-up.

11.32.04 Average Condenser Pressure

- i) Average Condenser pressure in mm Hg (abs) measured at 300 mm above the top row of condenser tubes with 840 MW output, 0% make up, design CW temperature and design CW flow.

Note: The condenser pressure measurement while conducting the guarantee tests from .01 to .04 above shall be measured at 300 mm above the top row of condenser tubes.

11.32.05 Steam Generating Capacity

- i) Steam generating capacity in Tons/hr of steam at rated steam parameters at superheater outlet & rated steam temperature at reheater outlet (with any combination of mills working as per Owner's discretion) with the coal being fired from within the specified range in Volume – II, Section – 1, Project Information.

11.32.06 Auxiliary Power Consumption for Station (Plant) Auxiliaries

- i) Station (plant) auxiliary power consumption comprising of all station Auxiliaries, required for continuous station operation at 1 x 800 MW (i.e. 100% rated load of the unit) under rated steam conditions and at condenser pressure of 77 mm Hg (abs) with 0% make-up with design coal shall be guaranteed in line with the requirements stipulated in subsequent clauses of this sub-section.
- ii) Note: Power consumption of each of the pump/fan/compressors/ Conveyors etc. wherever mentioned shall be measured with its own drive at the switchgear end.

11.32.07 Life of Coal Pulveriser Wear Parts

- i) Life of coal pulveriser wear parts, in hours of operation, for the entire range of coal characteristics specified.

11.32.08 Limestone Consumption Rate

- i) Limestone consumption of FGD system in kg/hr under guarantee point conditions, as mentioned in the FGD section shall be demonstrated.

11.32.09 APH Leakage

- i) APH leakage; not more than 5%.

11.32.10 Cooling Tower

- i) The cold-water temperature of 33 deg C shall be guaranteed for the design conditions of CW flow, range, ambient WBT and RH as per the performance test procedure of cooling tower elaborated elsewhere in the specification.



- ii) "Predicted cold water temperature" shall be arrived from the guaranteed cold-water temperature by correcting the same for the test conditions of range, ambient conditions and circulating water flow using the performance curves furnished by the contractor. In case the "Test cold water temperature" is higher than the "Predicted cold water temperature", Employer reserves the right to accept the tower after assessing the liquidated damages. The liquidated damages for shortfall in cold water temperature shall be worked out for all the cooling towers as per relevant clause &
- 11.32.11 FOR THE ABOVE PURPOSE, RESPECTIVE (CAT-I) PERFORMANCES / GUARANTEES WILL BE COMPUTED AND ESTABLISHED AS FOLLOWS:

- i) *Unit Heat Rates are to be computed as below:*

$$\text{UNIT HEAT RATE (@100\%)} = \frac{\text{Turbine Cycle Heat Rate (THR @100\%)}}{\text{Steam Generator Efficiency (SG_EFF @100\%)}}$$

And

$$\text{UNIT HEAT RATE (@55\%)} = \frac{\text{Turbine Cycle Heat Rate (THR @55\%)}}{\text{Steam Generator Efficiency (SG_EFF @55\%)}}$$

- ii) To establish the above, following tests for Turbine Cycle Heat Rate and Steam Generator Efficiency shall be conducted simultaneously but independently:
- a) Following tests for Turbine Cycle Heat Rate and Efficiency of Steam Generator shall be conducted simultaneously, but independently:
- 1) Turbine Cycle Heat rate in kcal/kWhr under rated steam conditions at 77 mmHg(abs) Condenser pressure with zero make up at 800 MW unit load (i.e. 100% of rated load).
 - 2) Efficiency of the Steam Generator at 800 MW unit load (i.e. 100% of rated load) with 27 degree Celsius ambient temperature and 60% RH, while firing the design coal, at rated steam parameters, rated coal fineness and rated excess air.
 - 3) Turbine Cycle Heat rate in kcal/kWhr under turbine throttle main steam pressure corresponding to 55% load and turbine throttle main steam temperature / reheat steam temp. at turbine inlet of 600 deg C / 610deg C (as selected) at 77 mmHg(abs) Condenser pressure with zero make up at 440 MW unit load (i.e. 55 % of rated load) with one TDBFP in operation. HMBD shall also be submitted for this load by bidder.
 - 4) Efficiency of the Steam Generator at 440 MW unit load (i.e. 55% of rated load) with 27 degree Celsius ambient temperature and 60% RH, while firing the design coal, at rated steam parameters, rated coal fineness and rated excess air.

iii) *Turbine Cycle Heat Rate -*

- a) Turbine cycle heat rate at TMCR unit loads, after subtracting excitation power and power of TG integral auxiliaries with following conditions:
- 1) Cycle make-up : 0% makeup
 - 2) Cooling water inlet temperature of 33 °C
 - 3) TDBFP's in operation
 - 4) Generator power factor of 0.85
 - 5) Condenser pressure of 77mmHg (abs)
- b)
- c) Turbine Cycle Heat Rate shall be calculated as follows & indicated in all computed heat balance diagrams:

$$\text{HEAT RATE} = \frac{M_1(H_1 - h_1) + M_2(H_3 - H_2) + M_{IS}(h_1 - h_{IS}) + M_{IR}(H_3 - h_{IR})}{P_G}$$

Where,

M_1 = Quantity of live steam entering the turbine stop valve including any live steam supplied to valve stems, or glands etc. in Kg/hr

M_2 = Quantity of steam from turbine to reheater in Kg/hr

M_{IS} = Quantity of Superheater desuperheating spray flow in Kg/hr

M_{IR} = Quantity of desuperheating water flowing into reheater system for regulation of steam temperature in Kg/hr

H_1 = Enthalpy in kcal/kg of live steam

H_2 = Enthalpy in kcal/kg of steam to reheat

H_3 = Enthalpy in kcal/kg of reheated steam

h_1 = Enthalpy of feed water in kcal/kg at the downstream of the junction of feed flow and bypass flow of HP heaters

h_{IS} = Enthalpy of superheater desuperheating spray water in Kcal/Kg

h_{IR} = Enthalpy of desuperheating water flowing into reheat system in Kcal/Kg

P_G = Unit output after deducting the power consumption by auxiliaries as listed below and the same shall be 840MW @105%, 800MW @100% and 440 MW @ 55% TMCR unit load –

- 1) Power taken by Excitation system (kW) including transformer losses, as applicable for various guarantee points, in case of static excitation system is offered. (The transformer losses at various points shall be based on factory test to be conducted)
- 2) Power required for ventilation of oil and control fluid tanks, if ventilating fans are separately driven (kW)



- 3) Power required for lubrication, if lubricating pumps are separately driven (kW)
- 4) Power required for control fluid pumps, if control fluid pumps are separately driven (kW)
- 5) Power required for hydrogen, seal oil auxiliaries, if separately driven (kW)
- 6) Power required for stator water cooling system, if cooling pumps are driven separately (kW)
- 7) Power required for Gland Steam Exhauster (GSC) if GSC Exhausters are separately driven.
- 8) Power required for motors, heaters etc. of any other auxiliary service for the turbine generator (kW)

Note: The calculation formulae shall suitably be corrected or values to be considered depending on spray water tapping location, feed water flow measurement location.

- d) Superheater and reheater spray component will be decided based on the desuperheating arrangement.
- iv) It may be noted that the heat balance diagrams and guarantees shall be furnished considering zero spray water quantity for superheater and reheater spray. During Performance Guarantee Testing, in case water is required for superheater and/or reheater temperature control, the bidder shall be entitled to heat rate correction as per correction curves to be submitted by him with his offer.
- v) *Applicable Corrections for Heat Rate, Output and Condenser Pressure*
 - a) Based on the cycle conditions and covering entire range of operation for Turbine, following correction curves for variation in Turbine Cycle Heat Rate i.e. @105%, @100% & @55% TMCR load and TG output to be furnished along with bid:
 - 1) Variation in main steam pressure and temperature
 - 2) Variation in reheater steam temperature
 - 3) Correction curves, if applicable, due to change in reheater spray quantities with respect to coal properties
 - 4) Variation in condenser pressure for main condenser
 - 5) Variation of power factor, frequency, generator hydrogen pressure and voltage.
 - 6) Change in system water storage.
 - b) Above correction curves shall be provided for following cases:
 - 1) 105% of TMCR for output guarantee
 - 2) 100% of TMCR for heat rate guarantee
 - 3) 55% of TMCR for heat rate guarantee



Note: In case, any of the above correction curves are not submitted along with price bid, no negative corrections shall be allowed on Turbine Heat Rate, on this account. Positive corrections, if required to be applied, then the amount shall be decided by Owner.

- c) Corrections Applicable for Condenser Pressure Guarantee
 - 1) Variation in Cooling Water Temperature
 - 2) Variation in Cooling Water Flow
 - 3) Variation in Heat Load
- d) It may be noted that the Heat Balance Diagrams and Guarantees shall be furnished considering the quantities of water for reheater sprays with owner's choice of any mill combination in service. For reheater, the spray quantities used shall not exceed the limits specified elsewhere in the specification. During PG testing, in case, the spray quantity used are at variance from the values used in the heat balance diagrams, the actual values will be used for calculation of heat rate and no correction shall be allowed.
- e) However, correction on account of variation in Reheater spray quantities, with respect to values used for the purpose of turbine cycle heat rate values shall be permitted only to the extent that such variations are solely attributable to the change in coal properties, with respect to those specified for the design coal. Bidders shall necessarily include the correction curves for variation in reheater spray quantities with coal properties in his bid proposal, failing which no corrections shall be permitted.
- f) The above list of correction curves are conclusive and curves in addition to above shall not be applied.
- vi) During the PG tests, through heat rates will be calculated for VWO condition / 105% of TMCR; but Category-I guarantees will be applicable to -
 - a) Unit Heat Rate at 100% TMCR Load
 - b) Unit Heat Rate at 55% TMCR Load
- vii) *Steam Generator Efficiency*
 - a) Steam Generator efficiency quoted by the bidder shall comply with following limiting parameters:
 - 1) Firing design coal
 - 2) On Gross Calorific value (GCV) basis
 - 3) At 27°C DBT and 60% RH ambient air conditions
 - 4) Excess air at economizer outlet -20%
 - 5) Corrected flue gas temperature at air preheater outlet
 - @105% TMCR - 129°C or as predicted by the Bidder whichever is higher
 - @100% TMCR - 125°C or as predicted by the Bidder whichever is higher



- @55% TMCR – 120°C or as predicted by the Bidder whichever is higher
- 6) Unburned fuel at all guaranteed efficiency load i.e. 1.25% (max.) of BA and 0.25% of FA on mass basis.
- b) Bidder to note that no credit shall be given in the bid evaluation or in the evaluation of the results of the guarantee tests for performance predictions/ guarantees etc. if the values considered by the Bidder for parameters indicated at 4, 5 & 6 above are lower than those specified above.
- c) Major requirements/methods of steam generator efficiency tests is as below:

1)	Test Code	As per PTC 4 / B S EN12952-15,2003 (by loss method)
2)	Test loads	105%TMCR(840MW /VWO unit Load)
		100%TMCR(800MWunitLoad)
		55% TMCR (440 MW unit Load)
3)	Test conditions	Boiler operating with rated excess air, coal fineness and firing design coal.
4)	Ambient air condition	Dry bulb temperature and Relative humidity shall be as specified above. The reference air temperature for the efficiency guarantee/testing shall be taken as the temperature of air (as the design temperature of air) entering PA and FD fans.
5)	No. of readings	Two sets of consistent readings for each of test loads. Average of the test efficiencies based on above two readings for each load shall be considered for guaranteed efficiency.
6)	Correction to tested efficiency shall be applicable for variation in following parameter only-	
	•	Ambient air temperature.
	•	Relative humidity of ambient air.
	•	Hydrogen in coal.
	•	Moisture in coal.
	•	GCV of coal.
	•	Percentage of ash in coal.
7)	The number, location, type and accuracy of the test grade thermocouples and pressure gauges shall be to Owner's approval	
8)	The Steam Generator efficiency testing shall be carried out with any combination of mills in operation to Owner's choice, with fineness of pulverized coal not exceeding 70% through 200 mesh.	
9)	The duration of the test shall be at least four hours. No Soot blowing shall be allowed during the stabilisation period, i.e. for at least four (4) hours prior to commencement of the PG test and also during the test period.	



- 10) Steam generator efficiency shall be with guaranteed or actual air heater leakages, whichever is higher.

d) Major requirements/methods of steam generator efficiency tests

S. No.	Losses to be Measured	Remarks
1)	Loss due to radiation from furnace bottom	To be calculated based on furnace bottom hopper opening and heat flux in this area.
2)	Loss due to unburned carbon	Ash samples will be collected from furnace bottom hopper, Air heater, Economiser and ESP hoppers, duct/SCR hoppers (if applicable). The ash collection rate for computation of losses shall be 20%, 3%, 5% in the furnace bottom hopper, air heater, economiser, duct/SCR hoppers (if applicable) and balance in ESP hoppers. The unburned carbon loss for Steam Generator Efficiency at each load shall be taken as 1.25% (max.) of BA and 0.25% of FA on mass basis.
3)	Loss due to sensible heat in ash	To be calculated based on the ash collection rates indicated above and ash temperature of furnace bottom ash as 1040 °C or actual, whichever is higher Temperature of Duct / economiser ash, SCR hopper ash, Air heater hopper ash, ESP ash shall be considered same as that of flue gas in these areas.
4)	Loss due to Mill Rejects	The total mill rejects throughout of the test (minimum four hours) from all mills shall be considered as one gross which will be weighed to measure the reject rate and then reduce by halving and quartering to the required sample size for calorific value analysis to be used for working out loss due to mill rejects.

- e) Computation other heat losses will be as per PTC-4 / BS EN 12952-15.
- f) Inlet air moisture to be considered in the vapour phase.
- g) Bidder shall furnish the correction curve, for Owner's approval, covering the expected ranges of variations, for all parameters, for the range of coal specified.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- h) The guaranteed steam efficiency shall be without any heat credit.
- i) For all other aspects, not spelt out here, or in the specifications, where PTC/BS code stipulates the agreement between the parties concerned, before commencement of the PG tests, the Bidder shall get these approved by the Owner. However, no correction to SG efficiency on account of variation in Turbine Cycle parameters, or vice versa, shall be allowed.
- viii) Gross Continuous TG Power Output
- a) Gross continuous TG power output at 100% TMCR after subtracting excitation power and power of TG integral auxiliaries with following conditions:
- 1) Cycle make-up: 0% makeup
 - 2) Cooling water inlet temperature of 33 °C.
 - 3) Generator power factor of -0.85
- ix) *Steam generating capacity*
- a) Steam generating capacity in T/hr of steam at rated steam parameters at superheater outlet & rated steam temperature at reheater outlet (with any combination of mills working as per Owner's discretion) with the coal being fired from within the range specified at the following conditions with heaters out of service condition:
- 1) BMCR condition
 - 2) TMCR conditions
 - 3) TMCR with all HP heaters out of service condition
- x) Auxiliary Power Consumption(APC)
- a) The Auxiliary Power Consumption for Station (1x800MW plant) are to be calculated to calculate the respective guaranteed power consumption as is illustrated hereunder:
- b) The station auxiliary power consumption shall be calculated using the following relationship, with design coal-

$$P_{AS} = P_S + T_{Ls}$$
$$\&$$
$$P_S = \text{SUM} (P_i \times D_i)$$

Where,

P_{AS} =Guaranteed Station Auxiliary Power Consumption

P_S = Total Power Consumption, while running the unit at 100% design load for all auxiliaries of the (1x800MW) station, supplied by the Bidder under this Package.

P_i = Power consumed by each station auxiliary

D_i = Duty factor to be considered for each station auxiliary



T_{Ls} = Losses of the Generator transformers, Unit Transformers, Station transformers and that of any other Transformers associated with station auxiliary power supply system and shunt reactor supplied by bidder, for meeting station auxiliary power supply, based on works test reports. While guaranteeing the auxiliary power consumption the bidder shall necessarily include all continuously operating auxiliaries.

- c) Losses of transformers shall be considered based on the works test reports as per the criteria specified in subsequent clauses under the subheading Transformers.
- d) While guaranteeing the station auxiliary power consumption the bidder shall necessarily include all the station auxiliaries running at full load with duty factors as have been defined herein.
- e) The power consumption of entire BTG unit auxiliaries fed from unit transformers shall be measured at the incomers of respective unit boards. Suitable correction for auxiliaries not in service at the time of this measured power consumption like MDBFP etc, shall be done on as per the technical specification. If GCB scheme is adopted, suitable corrections for station auxiliaries shall be done.
- f) The bidder shall furnish a list of equipment to be covered under auxiliary power consumption, which shall be subject to Owner's approval.
- g) The auxiliaries to be considered shall include but not be limited to the following:
 - 1) Turbine generator and auxiliaries
 - Turbine unit oil purifier
 - Turbine unit control oil purifier
 - Booster pumps for TDBFP (if applicable)
 - TDBFP lube. Oil pumps
 - Feed and discharge pumps of turbine oil purification system
 - Oil purifiers of TDBFP including feed and discharge pumps
 - Electric oil heater of TDBFP lube Oil (if applicable)
 - Electric oil heater for turbine lube oil tank (rated power shall be considered)
 - Vapour extractor fan motors
 - MDBFP Auxiliary Oil pump (if applicable)
 - Condensate Extraction Pumps (CEP)
 - TG control oil pumps
 - Oil pumps for HP & LP bypass system
 - Condenser air evacuation equipment (Vacuum pumps)



- BFP drive turbine condenser air evacuation pumps (if applicable)
 - BFP drive turbine condenser extraction pumps (if applicable)
 - COLTCS
 - Drip pumps (if applicable)
 - Chemical Dosing pumps
 - Hotwell make up pumps (Duty factor - 0.2)
 - CW Pumps, including all auxiliaries
 - Other auxiliaries (Bidder to list all other continuously/intermittently running equipment)
- 2) Steam Generator and Auxiliaries
- Primary Air (PA) Fans including its lube oil pumps
 - Coal Feeders
 - Seal air fans
 - Coal mills including its lube oil pumps
 - Forced Draft (FD) Fans including its lube oil pumps
 - Regenerative Air Preheater including its lube oil pumps
 - Induced Draft (ID) Fans including its lube oil pumps
 - Boiler circulation pumps
 - Scanner air fans
 - Electrical Heat Tracing (if applicable)
 - Other auxiliaries (Bidder to list all other continuously/intermittently running equipment)
- 3) SCR system and auxiliaries
- Ammonia forwarding pump
 - Dilution air fan
 - Other auxiliaries (Bidder to list all other continuously/intermittently running equipment)
- 4) Electrostatic precipitators (ESP) –
- With all TR sets , all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable) of all ESP passes working and rapping system in normal operation. During the test all hopper heaters including wrap around heaters of adapters, if applicable & all insulator heaters/pent house fans (if applicable)of all ESP passes will be in ON condition and set point temperature shall be kept 5 degree Celsius above the flue gas temperature.



- The measurement for guaranteed auxiliary power consumption shall be carried out during ESP collection efficiency test. The method for computing the power shall be as described below:-
 - Power consumption of ESP will be measured pass wise and for one pass/stream (Say ESP-A) at a time with the help of energy meter in ESP MCC.
 - Energy meter reading will be taken before starting the collection efficiency test and after completion of collection efficiency test.
 - Before starting collection efficiency test, switch off all the TR sets, all hopper heaters, all insulator heaters/pent house fans (if applicable) and rapping systems serving to one pass (ESP-A) temporally and note down energy meter readings for period t1 i.e.E1. The power consumption shall be $W1=E1/t1$.
 - During the collection efficiency test the total energy fed in to ESP MCC of one pass (say ESP-A) will be measured during entire period of collection efficiency test i.e. E2. Total time period (t2) of test shall be noted. The power consumption shall be $W2=E2/t2$. During the test all hopper heaters of all ESP passes will be in ON condition and set point temperature shall be kept 5 °C above the flue gas temperature.
 - Measured power consumption for one ESP pass (say ESP-A)= $(W2-W1)$
 - Measured Electrostatic Precipitator power of one unit= Power of (ESP-A + ESP-B +ESP-C + ESP-D + ESP-E + ESP-F and so on)
- 5) FGD system
- Absorber recirculation slurry pumps
 - Air oxidation blowers
 - Gypsum bleed pump
 - All Process/filter water pumps / slurry pumps
 - Gypsum dewatering system - Vacuum belt filter, vacuum pump, filtrate pump & agitator, waste water pump and agitator
 - Lime stone preparation system – gravimetric feeder, grinding mill, Mill circuit pumps, limestone slurry pump and agitator
 - All agitators
 - Lime handling system – Truck tippler, BTU unit / conveyors, feeders, Bucket elevator
 - Gypsum handling System – Conveyors, trippers / Plough



- Other auxiliaries (Bidder to list all other continuously/intermittently running equipment)
- 6) Fuel Oil Handling system
 - LDO transfer pumps
 - LDO forwarding/pressuring pumps
 - Other auxiliaries (Bidder to list all other continuously/intermittently running equipment)
- 7) Mill Reject System
 - Mill Reject conveyors
 - Bucket elevators
- 8) Plant Instrument and Service Air Compressors & Air Drying Plant
 - Instrument Air Compressors
 - Service Air Compressors
 - ADP Heaters (if applicable)
 - ADP Blowers
 - Power consumption at rated duty point for compressors to be arrived based on shop test and power consumption at rated duty point for Air Drying plant to be arrived based on site test.
- 9) Air Conditioning System
 - Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of Chilling machines / VAM machine, Chilled water Pumps, Condenser water Pumps, Air handling unit (AHU) fans, cooling tower fans and other auxiliaries for the Air conditioning system of main plant building, FGD control room, ESP control room, AHP control room, service building. Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of auxiliary plants like ESP control rooms, FGD control rooms, AHP Control Room, CHP Control Room, Switchyard Control Room etc. Power consumption at motor input terminals of centrifugal fans of mechanical ventilation system.
 - ♦ Power consumption at rated duty point for water cooled chillers & air cooled condensing units shall be based on site test and for other drives like chilled water pumps, Condenser water Pumps & AHU/centrifugal fans shall be based on shop test.
- 10) Auxiliary Water System Pumps (Working Pumps)
 - Raw Water Pumps
 - Filter/Clarified water pumps



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

VOLUME - II

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- DM plant feed pumps
- CT-make-up pumps
- Ash Water Pumps
- All Pumps within WTP
- Service water pumps
- Potable water pumps
- DM water transfer pumps
- Waste water transfer pumps
- Any other pump/drive required for continuous operation of the plant.

11) DMCW / ECW system for common auxiliaries

- ECW system for common station auxiliaries (as provided). Total power consumption of all equipments (excluding envisaged standby ones) shall be included.
- ACW (booster) pumps of the unit
- DMCW pumps to supply cooling water on the primary (DM) side of the plate type heat exchangers in the closed loop Equipment cooling (Unit auxiliaries) water system.
- Other auxiliaries (Bidder to list all other continuously/intermittently running equipment)

12) Coal Handling Plant and Biomass handling plant

- Wagon tippler
- Side Arm charger
- Feeders
- Conveyors
- Screen
- Crusher
- Trippers
- Stacker cum reclaimers
- Travelling plough
- EOT mounted Scraper chain spreader
- Other auxiliaries (Bidder to list all other continuously/intermittently running equipment)
- For calculation of Auxiliary power consumption Total power consumption for all the equipments including auxiliaries with



single stream operation at its guaranteed capacity with longest coal conveying path shall consider

13) Ash Handling Plant

- Vacuum pumps
- Compressors
- Air Dryers
- Clunker Grinders
- Slurry pumps
- Drain Pumps
- Bottom Ash belt conveyor
- Bottom Ash crushers
- Bottom Ash overflow pumps
- Water pumps (LP water pumps, HP water Pumps, Economizer water pumps, seal water pumps, Fly ash water pumps, HCSD water pumps and Ash conditioner water pumps)
- Fluidizing air blowers
- Fluidizing air heaters
- Charge Pumps
- Ash mixers and feeders
- HCSD Pumps
- Other auxiliaries (Bidder to list all other continuously/intermittently running equipment)

14) Plant Illumination

- Indoor Lighting
- Outdoor Lighting

15) Electrical system

- Losses in Bus ducts (at rated load conditions)
 - Isolated phase bus duct (IPBD)
 - Segregated phase bus duct (SPBD)
- UPS power consumption (at rated load condition)
- DC System power consumption (at rated load condition)
- GCB Losses of Unit : Losses and fan power for Generator Circuit Breaker (if applicable)
- Other auxiliaries (Bidder to list all other continuously/intermittently running equipment)



GUJARAT STATE ELECTRICITY CORPORATION LIMITED
1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

VOLUME - II

SECTION - 2

REV. - A

16) Transformer losses

- Transformer losses (at rated capacity) shall include –
 - Iron loss
 - Copper loss
 - Cooler pump and fan loss
- Following transformers are included:
 - Generator Transformer losses (at rated Load Condition)
 - Unit auxiliary transformer losses (at rated load conditions)
 - Station transformer losses (at Unit rated load conditions)
 - Losses in all other service/auxiliary transformers (at rated load conditions)

17) Transformers

- ◆ Transformer losses (TL) shall be considered as per following (as applicable)-
 - GT – 100% no load loss, 54% of Copper losses & 100% Cooler Loss.
 - ST– 100% no load loss, 8% of Copper losses & 9% Cooler Loss.
 - UT – 100% no load loss, 52% of Copper losses & 50% Cooler Loss.
 - Aux/ LT Outdoor/ LT Indoor Transformer: 100% no load loss & 25% of Copper losses
 - Reactor – losses at rated voltage
- h) The above list is not comprehensive and only indicative. Bidder shall furnish the comprehensive list of equipment to be covered under station auxiliary system, which is to be considered under station auxiliary power consumption. That will be subject to Owner's approval.
- i) Duty factors for auxiliaries shall be as below:

S.No.	Component / Auxiliary	Duty Factor
1.	Fuel oil transfer and forwarding / pressurizing pumps	0.5
2.	Instrument Air compressors	0.6
3.	Service Air Compressors	0.33
4.	Air Drying plant (Heaters) (if applicable)	0.5
5.	Air Drying plant (Blowers) (if applicable)	1.0
6.	Air Conditioning equipments	0.5
7.	Bottom Ash Crushers	0.3125
8.	Bottom ash overflow pumps	1.0



S.No.	Component / Auxiliary	Duty Factor
9.	Bottom Ash belt conveyors	1.0
10.	H.P. Water Pumps	0.625
11.	L.P. Ash Water Pumps	1.0
12.	Economizer Water Pumps	1.0
13.	Seal water Pumps	1.0
14.	Slurry Pumps	1.0
15.	Transport Air compressors with Air dryer	1.0
16.	Vacuum Pumps	1.0
17.	Coal Handling plant	0.5
18.	Biomass Handling plant	0.5
19.	Limestone handling plant	1.0
20.	Gypsum Handling plant	1.0
21.	Outdoor Lighting	0.4

- j) Where duty factor is not indicated the same is to be considered as '1.0'.
- k) Generation from roof top solar during the test period shall be added to the total measured power consumption.
- xi) *Condenser Pressure in mm Hg (abs)*
- Performance test for design condenser pressure shall be conducted in accordance with latest edition of ASME PTC-12.2. The condenser pressure shall be measured with a vacuum grid utilizing ASME basket tips. The grid shall be fitted at 300mm above top row of condenser tubes.
 - The tube plug margin of 5%, as per design condition, shall be considered for condenser performance calculation at design condition.
 - The tube side fouling resistance for design condition shall be calculated as per specified cleanliness factor of 0.9. The tube side fouling resistance for actual test condition shall be measured as per methodology given in ASME PTC 12.2. Alternately, the same shall be calculated using expected actual cleanliness factor appropriately assessed on side ring the aspect of actual tube cleaning prior to conducting the test.
- xii) *Air pre-heater leakage*
- It shall be demonstrated that the air-heater air-in-leakage and maximum drift in air leakage do not exceed the guaranteed value or specified value (whichever is lower) of Technical specifications.
 - Above requirement needs to be complied with recirculation of flue gas from downstream of ESP.
- xiii) *Life of Coal Pulveriser Wear Parts*

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- a) The Bidder shall warrant the wear life of all wear parts of the coal pulveriser when grinding the specified range of coal(s). Pulveriser wear parts are defined as those parts of the pulveriser which are in contact with coal or coal dust and are likely to wear out during the operation of the pulveriser.
- b) The guarantee/warranty shall be demonstrated on each pulveriser during the Guarantee Trial Period (GTP) commencing after establishing successful operation of the pulveriser continuously for a period of not less than twenty four (24) hours, at or near its guaranteed rated capacity.
- c) The GTP for the respective wear part(s) shall be at least three years or the wear life of that wear part(s), whichever occurs later. The establishment of the warranty will be based on equivalent running hours of the pulveriser regardless of the specified coal. The average wear life (AWL) of the mill wear parts during GTP shall, however be corrected for the variation in YGP index for the coal fired during GTP.
- d) Minimum Guaranteed Life for various coal pulveriser wear parts shall be as indicated in relevant sections of the specification.
- e) The wear parts shall be considered to have passed their warranted operating life when they have successfully demonstrated their capability to meet the full load rated capacity of the pulveriser (as per requirements of relevant clause of Specification) during the guaranteed life of the wear part.
- f) No weld build-up or reversing of grinding elements will be permitted for achieving the guaranteed wear life. In case any of the wear part has worn out to such an extent that either the normal or safe operation of the pulveriser is jeopardized, if that part is not replaced/repared, or continuous use with this part may lead to exposure or wear of other parts which are not meant for the purpose of checking the shortfall in wear life, even if there is no reduction in pulveriser rated capacity, then the part shall be deemed to have outlived its wear life.
- g) If any of the wear parts fail to meet the warranted life, additional quantities of these wear parts shall be supplied on pro-rata basis as defined below. For the duration of this warranty period, the replacement wear parts shall be available to the Owner at the spare part price indicated in the Contract, adjusted as per terms and conditions of the Contract.
- h) Computation of liquidated damages for plant life of 10 years.
- 1) On the expiry of GTP (minimum 3 years), deficiency in the life of each wear part that has not fulfilled the warranty will be worked out on an item wise basis and shortfall so established due to reduced wear life and its implications for the plant life shall be worked out.
 - 2) The Bidder at no extra cost to the Employer shall provide one and half times the wear parts needed to make good the shortfall in the wear life for 10 years of plant life.
- i) The shortfall part settlement (SPS) will be calculated based on the actual wear life of the parts that have worn-out in the GTP on a pulveriser-by-

pulveriser basis. In this connection the procedure given below shall be followed.

- j) Pulveriser Warranty Shortfall Part Settlement (SPS) Procedure (With Example), for all wear parts of each coal pulveriser:

S. No.	Description	Procedure	Example
1)	Guaranteed wear life of wear part	Say, X – hours	X = 16000 hrs
2)	Total life achieved by a particular wear part during GTP	Say, X1 hours by Originally installed part(s), & X2 hours by Subsequently replaced part(s)	X1 = 13,000 hrs X2 = 14,000 hrs
3)	Average Wear Life (AWL) of failed wear part(s)	$AWL = (X1+X2)/2$	AWL = $(13000+14000)/2$ = 13500 hrs
4)	Shortfall in hours Total shortfall for wear part during GTP	$S = (X-X1)+(X-X2)$	S = $(16000-13000) + (16000-14000)$ = 5000 hrs
5)	GTP in years	$GTP = (X1+X2)/8760$	GTP = $(13000+14000)/8760$ = 3.08
6)	Shortfall Part Settlement	$SPS = (S \times 10)/(AWL \times GTP)$	SPS = $(5000 \times 10)/(13500 \times 3.08)$ = 1.202 (To be rounded off to nearest whole number) = 1.0

- k) The Bidder shall provide to Owner either the wear parts of original or better quality material in number equivalent to one and half times the quantity worked out based on the method explained in the above example so as to compensate for the shortfall in wear life for a plant life of 10 years as has been established above, or the cost of such number (i.e. one and half times the quantity worked out as per the above example) of wear parts based on the prices agreed for mandatory spares.
- l) The final mode of compensation for such shortfall viz. by means of additional quantities of spares worked out or by cost thereof shall be as per Owner's discretion. The total cost of such replacements shall be without



any limit to the maximum amount recoverable subject to the provisions of this Specification.

- m) The credit of one and half times of shortfall in wear parts life shall also apply for already supplied mandatory spare parts under this contract based on average wear life achieved during GTP period.
- n) Average Wear Life (AWL) during GTP, to be considered for pulveriser wear part warranty shall be as arrived at from the station record for each pulveriser, and as corrected for variation in YGP index of the coal being fired during GTP. For this purpose the coal YGP shall be the average tested value during GTP. The Bidder shall collect the coal samples and get them tested for YGP index at recognized, Owner's approved test lab, periodically. (The frequency of sampling and testing shall be mutually agreed between Bidder & Owner). The YGP index testing shall be done as per the BS Standard specified. A jointly signed record shall be maintained during GTP.
- xiv) Lime stone consumption
 - a) Limestone consumption for FGD system Limestone consumption of FGD system in kg/hr under guarantee point conditions.
- xv) SCR Catalyst Life
 - a) Bidder shall guarantee and demonstrate minimum SCR catalyst life of 16000 hrs. The catalyst shall be deemed to have exhausted its life as and when SCR/efficiency for control of NOx emission reaches to a level of 70%, with ammonia slip not exceeding 3ppm at 6%oxygen (O₂) content in flue gas on dry gas basis.
- xvi) Ammonia consumption for DeNOx /SCR system.
 - a) Guaranteed Ammonia consumption rate (in Kg/hr/unit, 99.5 wt %) at 100% TMCR for firing coal from the range of coal(s) specified shall be demonstrated. The ammonia consumption rate shall be measured during the test for SCR efficiency for control of NOx emission.
- xvii) Cooling Tower
 - a) The cooling water temperature of 33 °C shall be guaranteed for the design condition of CW Flow, Range, Ambient WBT and RH as per the performance test procedure of Cooling Tower, as elaborated in respective section of the specification.
 - b) "Predicted Cold Water Temperature" shall be arrived from the guaranteed Cold-Water Temperature by correcting the same for the test conditions of Range, Ambient conditions and CW flow, using the performance curves furnished by the bidder
 - c) In case the "Test Cold Water Temperature" is higher than the "Predicted Cold Water Temperature", Owner reserves the right to accept the Cooling Tower, after assessing the liquidated damages.
 - d) The liquidated damages for shortfall in cold water temperature shall be worked out for cooling tower as per relevant clauses & section



xviii) Transformer Losses

- a) The transformer losses shall be guaranteed by bidder as per list attached. The LD shall be levied as specified separately. This LD shall be over and above the LD for auxiliary power consumption.

11.33.00 Guarantees under Category – II (Performance Guarantees under rejection) are as follows:**11.33.01 NO_x EMISSION**

- i) It shall be guaranteed that maximum total NO_x emission from the unit shall not be more than 80 mg/Nm³(from thermal as well as fuel) per giga joule of heat input (at during the entire operating range of steam generator for the range of coals specified.
- ii) The emission shall be measured during steam generating capacity test. The bidder shall furnish the methodology of measurement and demonstration of variations w.r.t. load upto50% of total load.

11.33.02 SO_x EMISSION

- i) It shall be guaranteed that maximum total SO_x emission from the unit shall not be more than 70 mg/Nm³, (at 6% O₂ dry basis), during the entire operating range of steam generator for the range of coals specified.

11.33.03 PARTICULATE MATTER EMISSION

- i) It shall be guaranteed that, with one field out of service in each stream/pass, the particulate emission from ESP at TMCR load and design coal firing shall not exceed 30 mg/Nm³. The corresponding ESP efficiency shall be worked out.

11.33.04 NOISE LEVEL

- i) All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in the technical specifications.

11.33.05 FOR THE ABOVE PURPOSE, RESPECTIVE (CAT-II) PERFORMANCES / GUARANTEES WILL BE COMPUTED AND ESTABLISHED AS FOLLOWS:

- i) Particulate Matter Emission from Electrostatic Precipitator
- a) The performance/acceptance tests shall be carried out in accordance with method-17 of EPA (Environmental Protection Agency of USA) code. The details of the test shall, however be mutually agreed upon between the Owner and the Bidder.
- b) The particulate emission from ESP shall not be more than 30 mg/Nm³ under guarantee point condition at TMCR load with design coal firing. The corresponding ESP efficiency shall be worked out.
- c) The ESP air in leakage shall not be more than 1% of total gas flow at ESP inlet at the guarantee point condition and shall be demonstrated.
- d) The maximum pressure drop through the ESP at the guarantee point flow condition shall not exceed 25 mm WC, which shall be demonstrated.
- e) The gas distribution in the various stream and fields shall be demonstrated.



f) Method of computing test efficiency of ESP

- 1) The performance test on electrostatic precipitator will commence after a minimum period of three thousand (3000) hours of cumulative operation after completion of initial operation. During the interval between the commencement of trial operation and the commencement of performance test only routine maintenance shall be carried out. No physical or chemical cleaning of ESP shall be permitted during this period or immediately before the conductance of the performance tests.
- 2) The test efficiency shall be based on the overall performance of the electrostatic precipitator over a mutually agreed period of operation under the conditions given in this specification and allowing the normal operation of the unit including rapping and normal soot blowing and/or when fuel oil is being fired in the igniters and/or warm up guns.
- 3) The overall test efficiency and test temperature/inlet dust burden for one set of ESP passes (stream) serving one Steam Generator shall be worked out as follows:
 - Vm (guarantee point test flow) shall be the total of inlet gas flows to the all the gas streams at the time of test.
 - Test inlet dust burden (Di) shall be weighted mean of the inlet dust burdens for the individual streams i.e.:

$$D_i = \frac{(V_{m1} \times D_{i1}) + (V_{m2} \times D_{i2}) + (V_{m3} \times D_{i3}) + (V_{m4} \times D_{i4}) + (V_{m5} \times D_{i5}) + (V_{m6} \times D_{i6})}{(V_{m1} + V_{m2} + V_{m3} + V_{m4} + V_{m5} + V_{m6})}$$

Where suffix 1, 2, 3, 4, 5 & 6, represent the six gas streams; The formula will be revised accordingly, if the no. of streams vary.

Similarly, the test outlet dust burden (Do) will be calculated based on outlet gas flow.

- The weighted test inlet gas temperature (Ti) shall also be worked out in a similar manner i.e.

$$T_i = \frac{(V_{m1} \times T_{i1}) + (V_{m2} \times T_{i2}) + (V_{m3} \times T_{i3}) + (V_{m4} \times T_{i4}) + (V_{m5} \times T_{i5}) + (V_{m6} \times T_{i6})}{(V_{m1} + V_{m2} + V_{m3} + V_{m4} + V_{m5} + V_{m6})}$$

- The measured test efficiency shall be

$$E_m = \frac{D_i - D_o}{D_i} \times 100 (\%)$$

- The corrections for the variation in flue gas flow, inlet dust burden and ESP inlet flue gas temp. shall be based on the above



computed test values and the procedure indicated in the next para.

Note: 5th& 6th gas stream if applicable

- 4) At the time of performance testing if the inlet flue gas conditions are not consistent with the specified conditions, due to variation in coal characteristics from the design coal and boiler operating conditions the precipitator performance conforming to this specification, shall be determined using performance curves and correction factors accepted at the time of award of contract. However, the test efficiency shall be corrected to the guarantee point conditions in the following manner:

- $E_c = 1 - e^Z$

Where,

E_c = Corrected test efficiency to guaranteed point conditions

$$Z = C \cdot L_n (1 - E_g)$$

$$C = 1/(C_a \times C_b \times C_c \text{ etc.})$$

C_a , C_b , C_c etc. are correction factors for flue gas at temperature, ESP inlet dust loading and sulphur based on correction curves furnished by the bidder and approved by the owner.

- $E_g = 1 - e^Y$

Where,

$$Y = (V_m/V_g)^{0.5} L_n (1 - E_m)$$

E_g = Measured test efficiency corrected to the specified guaranteed point flow

V_g = Specified guaranteed point gas flow (m3/sec)

V_m = measured gas flow {m3/sec}

E_m = Measured test efficiency

L_n = Logarithm, natural base

- 5) The correction curves should be realistic for expected range of operation and variation in characteristic specified.
- 6) The test efficiency shall be the average of at least three corrected test efficiencies

ii) Method of Computing Test Efficiency of FGD

- a) The performance tests shall be carried out in accordance with ASME PTC 40 (2017) code.
- b) The details of the test shall, however be mutually agreed upon between the Owner and the Bidder.



iii) Noise Levels

- a) Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of BS EN61672-1, 2 & 3 / IS 15575.
- b) Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation.
- c) A minimum of 6 points around each equipment, shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A-weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.

11.34.00 Guarantees under Category – III (Performance Guarantees under compulsory correction) are as follows:

11.34.01 START-UP

- i) Start-up time (upto full load), and loading capabilities for the complete unit (boiler, turbine and generator together) for cold start, warm start and hot start conditions as agreed shall be demonstrated, ensuring that the various turbine operational parameters like vibration, absolute and differential expansion, eccentricity and steam metal temperature mismatch etc. are within design limits.

11.34.02 UNIT LOAD RAMP RATE CAPABILITY

- i) Unit load ramp rate capability shall be demonstrated as per the requirements of the specification, ramp-up up to 100% load and ramp down up to minimum continuous operating load; while maintaining the parameters within prescribed limits.

11.34.03 MINIMUM CONTINUOUS LOW LOAD OPERATION

- i) Minimum continuous low load operation, without oil support, when firing with the coals from the range identified. The contractor shall demonstrate that with any combination of mills/adjacent mills in service (to Owner's choice) the Steam Generator does not require oil firing for stable boiler operation at the minimum specified load.

11.34.04 STEAM GENERATOR AND AUXILIARIES

- i) The total attemperation water flow quantity for super heater steam temperature control T/hr
 - a) 100% TMCR condition while firing design Coal
 - b) 100% TMCR condition while firing Worst Coal



- c) 80% TMCR condition under sliding pressure operation while firing design Coal
 - d) 80% TMCR condition under sliding pressure operation while firing worst Coal
- ii) The total attemperation water flow quantity for reheater steam temperature control with rated excess air
 - a) 100% TMCR condition while firing design Coal
 - b) 100% TMCR condition while firing Worst Coal
 - c) 80% TMCR condition under sliding pressure operation while firing design Coal
 - d) 80% TMCR condition under sliding pressure operation while firing worst Coal
 - e) It shall also be demonstrated that the RH temperature is maintained at the rated value without any spray water requirement under normal operating conditions (100% TMCR)
- iii) The super heater steam temperature at the high pressure (HP) turbine inlet under the following conditions(°C)
 - a) Range of Coal specified
 - b) Steam Generator load 60% TMCR to 100% BMCR under sliding pressure operation
- iv) The reheat steam temperature at the intermediate pressure (IP) turbine inlet under the following conditions (°C):
 - a) Range of coal specified
 - b) Steam Generator load 60% TMCR to 100% BMCR under sliding pressure operation
- v) Steam temperature imbalance
 - a) It shall be demonstrated at SH and RH outlets (in case of more than one outlet) that the temperature imbalance between the outlets does not exceed 10°C under all loads including transients.
- vi) Furnace exit gas temperature (FEGT)
 - a) It shall be demonstrated that maximum furnace exit gas temperature (FEGT) shall be as specified. A comprehensive thermal performance test (TPT) shall be conducted for this purpose on one unit only.FEGT shall be demonstrated through such TPT by indirect measurement, with coal pulveriser combinations of Owner's choice and all other requirement in line with Technical Specifications.
 - b) The demonstration shall be done by backward calculations method, after having measured/tested/calculated the economizer outlet gas temperature (average), excess air (average), unit heat load (based on turbine flow and reheater flow), characteristics of coal being actually fired during testing,



heat absorption in different stages of heat transfer equipments (based on steam/water temperature and pressure measurements) etc.

- c) FEGT for the specified design and worst coals shall be calculated using the measured FEGT (with test coal) as above and using computer modelling technique for necessary conversion of the results to the specified design and worst coals. The FEGT demonstration using computer modelling technique shall involve following steps:
 - 1) Development of a computer field model (FM) (backward) using above measured/computed field data. This will be used to calculate the surface effectiveness factor (SEF) for each of heat transfer banks including furnace water walls with test coal.
 - 2) The above field model shall have to be validated by various tests (loads, coal pulveriser combination etc. with test coal) to ensure SEFs for each bank are consistent (within $\pm 5\%$) for all tests.
 - 3) Using above SEFs, for each heat transfer bank contractor's original boiler design model will be changed to make it this 1X800 MW UNIT - 7 PROJECT specific'.
 - 4) The validity of the above model shall be checked for each test by feeding the test coal both from backward direction FM and the calibrated this '1X800 MW UNIT - 7 PROJECT specific' model as per above step. The model validity is established if the results for flue gas temperature profile in the boiler, zonal assumptions etc. are identical in both the 'BACKWARD' and 'FORWARD DIRECTION'.
 - 5) The validated "1X800 MW UNIT - 7 PROJECT" model shall have "Fuel Switching" capabilities. it shall be able to appropriately vary the furnace absorption with changes in the coal properties. Validation of the above fuel switching capability will also have to be established to the satisfaction of GSECL.
 - 6) Having established and demonstrated Fuel Switching capability, the contractual FEGT can be demonstrated by using the site specific calibrated model as per step-(d) and plugging in the specified coal(s).
 - 7) The detailed procedure and the correction curves for the above test shall be to Owner's approval.
- d) The Bidder through thermal performance test (TPT) as per above shall also demonstrate that the flue gas temperature (Actual/MHVT values) at the entry and exit of various boiler heating surfaces and also the variations across the cross section perpendicular to gas flow do not exceed the values indicated in the data sheets for 100% TMCR (800 MW).
- vii) Minimum stable load on the Steam Generator without oil support under the following condition (%)
 - a) It shall be guaranteed that oil support for flame stabilisation shall not be required beyond 30% of BMCR load or 35% TMCR load when firing the coals from the range identified.



- b) It shall be demonstrated that with any combination of mills/adjacent mills in service (to Owner's choice), the steam generator does not require any oil firing for stable and efficient boiler operation at and above 35% TMCR loads
- c) Minimum stable load without oil support shall be demonstrated under the following condition
 - 1) Range of coal specified
 - 2) Both Load ramp-up & ramp down
 - 3) Any combination of mills in operation
- viii) Coal consumption at 100% BMCR, and 100% TMCR for design coal and worst coal based on the following (T/h)
 - a) Ambient air temperature 27°C
 - b) Relative Humidity 60%
- ix) *Coal mills*
 - a) Performance testing shall be done on coal mills toward establishing its guaranteed capacity specified at the rated fineness, applying corrections for the variation in coal characteristics i.e., HGI (Hardgrove Grindability Index) and total moisture.
 - b) Loading of each mill when steam generator operating at 100% BMCR and 100% TMCR condition while firing design coal and worst coal
 - c) Coal fineness for the range of coal specified-
 - 1) Through 200 mesh screen
 - 2) Through 50 mesh screen
 - d) Capacity, efficiency and power consumption of each mill while firing design coal and worst coal (TPH) at:
 - 1) New Condition
 - 2) at 50% wear life
 - 3) at worn out condition
 - e) Capacity demonstration test shall be carried out for the following conditions:
 - 1) Capacity output of one coal pulveriser (of Owner's choice) of each Steam Generator shall be demonstrated for establishing its capacity at 100% mill loading, at rated pulverized coal fineness with specified design coal with new set of grinding elements.
 - 2) Capacity output shall also be demonstrated on four coal pulverisers (of Owner's choice) of Steam Generator, not less than the 90% of guaranteed value of 1) above, at 100% mill loading with the originally installed grinding elements in nearly worn-out condition or at the end of guaranteed wear life of grinding elements, whichever is earlier.



- f) Capacity test as mentioned at 1) & 2) above shall be demonstrated at the following conditions occurring simultaneously during testing:

Rated pulverised coal fineness	1) not less than 70% through 200 mesh and 2) not less than 98% through 50 mesh screen
Test coal	Any available coal from the specified range

- g) In case the guaranteed capacity of coal pulverisers as stated above are successfully demonstrated, remaining coal pulverisers of steam generator will also be considered to have successfully met the above capacity guarantee requirement. However, in the event of any of the coal pulverisers not meeting the guarantee test, all the coal pulverisers of corresponding steam generator will have to be tested to demonstrate guaranteed capacity.
- h) During the demonstration of the pulveriser capacity output, manufacturer's operating instructions will be followed and pulveriser will be operated with the specified range of coals without any such readjustment that requires a shutdown of the pulveriser or reduction of the load and/or any replacement of any pulveriser wear parts.
- i) For the purpose of testing to demonstrate the capacity, if HGI (grindability) and total moisture vary from those given in coal characteristics, the above pulveriser measured capacity shall be corrected using the capacity correction curves furnished by the Bidder and approved by the Owner. HGI versus coal pulveriser capacity curve shall be furnished for HGI variation up to a value above which the capacity remain constant.
- x) *Primary air fans*
- Capacity (m³/hr)
 - Head developed (mWC)
 - Fan efficiency (%)
 - Power consumption (kW)
 - Margins envisaged on capacity and head
- xi) *Induced draft fans*
- Capacity (m³/hr)
 - Head developed (mWC)
 - Fan efficiency (%)
 - Power consumption (kW)
 - Margins envisaged on capacity and head
- xii) *Forced draft fans*
- Capacity (m³/hr)
 - Head developed (mWC)



- c) Fan efficiency (%)
- d) Power consumption (kW)
- e) Margins envisaged on capacity and head
- xiii) *Seal air fans*
 - a) Capacity (m³/hr)
 - b) Head developed (mWC)
 - c) Fan efficiency (%)
 - d) Power consumption (kW)
 - e) Margins envisaged on capacity and head
- xiv) Satisfactory operation of FD, ID and PA fans without undue noise and vibration while operating in isolation or in parallel with other fans shall be demonstrated at site.
- xv) *Fuel oil firing system*
 - a) Percentage load for which LDO firing system is designed (% BMCR)
- xvi) *Run-back capabilities*
 - a) The automatic runback capability of the unit (boiler-turbine-generator) on loss of critical auxiliary equipment (such as tripping of one ID/FD/PA fan/ air heater etc.) shall be demonstrated ensuring smooth and stable runback operation, as mentioned in the technical specifications
- xvii) CO emission at 100% TMCR at rated excess air for specified range of coal
- xviii) Flue gas temperature at APH outlet (maximum) while firing design coal at 100% TMCR without considering air leakage, (°C)
- xix) Un-burnt carbon in bottom ash while firing design coal at 100% TMCR(%)
- xx) Un-burnt carbon in fly ash while firing design coal at 100% TMCR(%)
- xxi) Total un-burnt carbon loss while firing design coal at 100% TMCR (%)
- xxii) Surface temperature of thermal insulation with ambient temperature of 40°C at surface velocity of 0.25 m/s. (°C)
- xxiii) *FGD System*
 - a) Absorber outlet gas temperature
 - b) Absorber outlet gas moisture percentage.
 - c) Leak-proofness of dampers and gates.
 - d) Oxidation air blower performance (flow, temperature, pressure).
 - e) Wet Ball Mill Capacity at rated fineness
 - 1) The contractor shall demonstrate the guaranteed capacity of each limestone pulveriser under the following conditions:



Limestone fineness	90% or higher (as per the requirement of the absorber) through 325 mesh (for spray tower process) OR 90% or higher (as per the requirement of the absorber) through 200 mesh (for jet bubbling process)
Limestone Quality	All available quality from the specified range

- 2) Contractor shall demonstrate the above capacity with the originally installed grinding elements in nearly worn-out condition as mutually agreed for the purpose of ascertaining wear life of any of the wear parts.
- f) **Wet Ball Mill Wear Parts Guarantee**
 - 1) Contractor shall demonstrate the life of wet ball Mill wear parts in line with requirements stipulated in the Technical Specification. The establishment of the above guarantee shall be based on the operating records available at the Power station and will be computed for each pulveriser based on actual total hours of operation.
- g) **Wet Ball Mill Ball Consumption**
 - 1) Contractor shall guarantee ball consumption per ton of limestone throughput in line with requirements stipulated in the Technical Specification. Contractor shall furnish the minimum ball diameter below which the balls shall be replaced.
- h) **Pressure Drop Across FGD**
 - 1) The contractor shall demonstrate that the total pressure drop in the gas path across the FGD System shall not exceed the guaranteed values for the range of coal and loads specified in the Technical Specification
- i) **Vacuum Belt Filter Capacity**
 - 1) Contractor shall demonstrate the capacity of the Vacuum Belt Filters to dewater the quantity of gypsum with the specified purity and moisture content as specified in respective Technical Specification.
- j) **Gypsum Purity**
 - 1) The contractor shall demonstrate that the purity of the gypsum produced shall not be less than 90%, chloride content shall not be more than 100ppm and the moisture content shall not be more than 10% for the range of specified coal(s) and based on CaO content of 51% in limestone.
- k) **Limestone unloading stream**
 - 1) Bidder shall also demonstrate the guaranteed tipping rate of Truck Tipplers
 - 2) Capacity of all the equipment in the limestone unloading path up to the Storage silos should be demonstrated.



- l) Gypsum handling system
 - 1) Capacity of Gypsum conveyor taking feed from gypsum dewatering unit and feeding to gypsum storage shed.
- m) Guarantee tests all left out Conveyors/bucket elevators not appearing above along with all associated equipments shall also be considered.
- n) Mist Outlet Droplet Content
 - 1) The mist eliminator outlet droplet content shall be guaranteed to be < 20 mg/Nm³ at absorber outlet measured over a period of 24 hrs continuous operation. Mist outlet droplet content shall be measured as per applicable clauses in VDI Norm 3679 and the Contractor shall carry out the tests as per the test procedure approved by the Owner
- o) Waste Water

11.34.05 STEAM TURBINE AND AUXILIARIES

- i) Gross power output (MW) at 100% TMCR and VWO condition after subtracting excitation power and TG integral auxiliaries with following conditions:
 - a) Cycle make-up : 1% make-up
 - b) Cooling water inlet temperature of 33°C
 - c) Generator power factor -0.85
- ii) Gross power output (MW) at 100% TMCR after subtracting excitation power and TG integral auxiliaries with following conditions:
 - a) Cycle make-up : 1% makeup
 - b) Cooling water inlet temperature of 33°C
 - c) Generator power factor -0.85
 - d) All HP heaters out of service
- iii) Gross power output (MW) at 55% TMCR after subtracting excitation power and TG integral auxiliaries with following conditions:
 - a) Cycle make-up : 1% makeup
 - b) Cooling water inlet temperature of 33°C
 - c) Generator power factor -0.85
 - d) At 47.5Hz to 51.5 Hz
- iv) Continuous TG output of 105% of rated load (i.e. 840 MW unit load) under rated steam conditions after subtracting excitation power and TG integral auxiliaries
 - a) Cycle make-up : 1% makeup
 - b) Cooling water inlet temperature of 33°C
 - c) Generator power factor -0.85
 - d) At 47.5Hz to 51.5 Hz



Note: The condenser pressure measurement while conducting the guarantee tests shall be measured at 300 mm above the top row of condenser tubes.

- v) Turbine-generator set capability
 - a) The steam turbine generator shall be capable of delivering at generator terminals the output as indicated in the heat balances under the following conditions:
 - 1) Continuous TG output of 100% TMCR under rated steam conditions at 89 mm Hg (a) worst condenser pressure with 1% make up.
 - 2) While conducting this test, the condenser pressure measurement shall be done at 300 mm above the top row of condenser tubes.
 - b) The automatic runback capability of the unit (boiler-turbine-generator) on loss of critical auxiliary equipment (such as tripping of one BFP/CEP etc.) shall be demonstrated ensuring smooth and stable runback operation.
- vi) Upon sudden total loss of all external loads, unit will not trip on over speed but shall continue to be in operation to supply power for plant auxiliary load (house load).
- vii) Run-Back capabilities of the SG and STG upon loss of critical auxiliary equipment, shall ensure smooth and stable run back operation.
- viii) Variable pressure operating range (% TMCR)
- ix) *Condenser*
 - a) Total pressure drop in condenser tube side with design cooling water flow and temperature (mWC)
 - b) Total cooling water temperature rise (°C) in condenser with design cooling water flow and CW inlet temperature of 33 °C under the following condition:
 - 1) Unit operating at 100% TMCR condition
 - 2) Unit operating at VWO condition
 - 3) Unit operating with all HP Heaters out condition and generating 100% TMCR power output
 - 4) Unit operating under house load and HP & LP bypass operating at rated capacity
 - c) Condenser pressure
 - 1) Performance test for design condenser pressure shall be conducted in accordance with latest edition of ASME PTC-12.2
 - 2) Condenser pressure in mm Hg (abs) measured at 300 mm above the top row of condenser tubes under VWO conditions, 1% make up, design CW temperature and CW flow.
 - 3) The condenser vacuum shall be measured with a vacuum grid utilizing ASME basket tips.



- 4) Temperature of condensate, at outlet of condenser, shall not be less than saturation temperature corresponding to the condenser pressure at all loads.
- 5) Air leakage in the condenser under full load condition shall not exceed more than 50% of design value taken for sizing the condenser air evacuation system.
- 6) When one half of the condenser is isolated, condenser shall be capable of taking at least 60% TG load under TMCR conditions.
- 7) The capacity of each vacuum pump in free dry air under standard conditions at a condenser pressure of 25.4 mm Hg (abs) and sub cooled to 4.17°C below the temperature corresponding to absolute suction pressure shall not be less than 30SCFM. Correction curves for establishing the capacity at site conditions shall also be furnished.
- 8) The air and vapour mixture from air cooling zone of condenser shall be 4.17°C below the saturation temperature corresponding to 25.4 mm Hg (a) suction pressure. Correction curves for establishing the same at site conditions shall also be furnished.
- d) Tube plug margin of 5%, as per design condition, shall be considered for condenser performance calculation at design condition.
- e) If tube side fouling resistance for actual test condition is not measured as per methodology given in PTC 12.2, the tube cleanliness factor corresponding to the same shall be appropriately assessed considering the aspect of actual tube cleaning prior to conducting the test.
- x) *Condensate extraction pump CEP)*
 - a) Rated capacity (m³/h)
 - b) Rated Total Dynamic Head (TDH) (mWC)
 - c) Pump efficiency (%)
- xi) *Booster pump of CEP) (if applicable)*
 - a) Rated capacity (m³/h)
 - b) Rated Total Dynamic Head (TDH) (mWC)
 - c) Pump efficiency (%)
- xii) *Condensate polishing unit (CPU)*
 - a) Effluent quality of outlet of each vessel at its rated design flow and design service length between two regenerations
 - b) Chemical consumption for regeneration
 - c) Pressure drop across the polisher service vessel, as specified, in clean and dirty condition of resin at rated design flow.
 - d) Condensate water quality.
- xiii) *Feed water heaters*



- a) Pressure drop on the tube side of the individual LP heaters (Maximum) (mWC)
- b) Pressure drop on the tube side of the individual HP heaters (maximum) (mWC)
- c) TTDs and DCAs of feed water heaters shall be demonstrated as per guaranteed heat balance diagram for 100% TMCR condition.
- d) Outlet temperature from final feed water heater(s)
- xiv) *Deaerator*
 - a) Dissolved O₂ content at deaerator outlet without chemical dosing at all loads, not to exceed 0.005 CC/litre determined as per ASTM-D-888 – Reference method-A or Indigo Carmine method.
 - b) Difference between saturation temperature of steam entering the deaerator and temperature of feed water leaving the deaerator shall be demonstrated as per guaranteed heat balance diagram for 100% TMCR condition.
 - c) Continuous and efficient operation and performance of feed heating plant without undue noise and vibrations at all loads and duty conditions
- xv) *Boiler feed pump (BFP)*
 - a) Rated capacity (m³/h)
 - b) Rated Total Dynamic Head (TDH) (mWC)
 - c) Pump efficiency (%)
 - d) Noise
- xvi) *Booster pump of BFP*
 - a) Rated capacity (m³/h)
 - b) Rated Total Dynamic Head (TDH) (mWC)
 - c) Pump efficiency (%)
- xvii) Satisfactory operation of BFPs and CEPs without undue noise and vibration while operating in isolation or in parallel with other pumps shall be demonstrated at site.
- xviii) *Equipment cooling water system (ECW/DMCW)*
 - a) Capacity, head & power consumption of all the pumps with the respective job (own) motors to be demonstrated at shop. For the pumps which are included under "Unit Auxiliaries for calculation of Pu" as defined elsewhere the power consumption value (at rated duty point) during shop testing shall be considered for computation.
 - b) Vibration, parallel operation and noise level of all the pumps at the rated duty point shall be demonstrated at site
 - c) Design heat load of plate type heat exchangers and Inlet & Outlet temperatures of the Plate type heat exchangers on the primary and secondary side to be demonstrated at site. Pressure drop across the Plate



type heat exchanger on the primary & secondary water circuit to be demonstrated at site.

xix) *Condenser on-load tube cleaning system (COLTCS)*

- a) Life of sponge rubber balls and number of balls lost during 1000 hours of plant operation shall be as indicated by Bidder in the offer and accepted by the Owner.

xx) *HP & LP bypass system capability*

- a) The HP & LP bypass system should satisfy the following functional requirements under automatic interlock action. It should come into operation automatically under the following conditions:
 - 1) Generator circuit breaker opening
 - 2) HP & IP stop valves closing due to turbine tripping
 - 3) Sudden reduction in demand to house load
- b) Under all above conditions, while passing the required steam flows as per the relevant heat balances, the condenser should be able to swallow the entire steam without increasing the exhaust hood temperature and condenser pressure beyond the maximum permissible values. The same shall be demonstrated.

11.34.06 POWER CYCLE PIPING

- i) Actual hanger readings under cold and hot condition (at rated parameters) to match with those of design cold and hot hanger readings for MS/CRH/HRH/HP & LP bypass piping system

11.34.07 FUEL OIL SYSTEM

- i) Capacity, head and power consumption of all the pumps shall be guaranteed.
- ii) Vibration and noise level of all the pumps at the rated duty point shall be demonstrated at site
- iii) Above shall be demonstrated with individual and parallel operations.

11.34.08 *Mill reject system*

- i) Mill rejects conveyors capacity

11.34.09 GENERATOR

- i) Generator Maximum Continuous Rating (MVA)
- ii) Generator Efficiency (minimum) (%)
- iii) Hydrogen Make-up per day (m³/day)
- iv) Excitation system
 - a) Capacity of excitation transformer for static excitation (kVA)
 - b) Total loss of excitation transformer (kW)
 - c) Total loss of static excitation system (kW)
 - d) Total loss of brushless excitation system (kW)

**11.34.10 Compressor and Air dryers**

- i) Free air delivery at site conditions for each compressor (Nm³/min)
- ii) Power consumption at site rated parameters per each compressor (kW)
- iii) Maximum capacity of each air dryer at min working pressure and max. temp at after cooler outlet (Nm³/min)
- iv) Parallel operation of air compressors shall be demonstrated at site.
- v) Pressure drop across Air Drying Plant, Capacity and outlet dew point of each air drying plant shall be demonstrated at site.
- vi) Vibration level and noise level of each air compressor, blowers and any other rotating equipments of each air drying plant shall be demonstrated at site.

11.34.11 CW Pumps

- i) Each pump shall be tested at shop/ site (as applicable) for capacity, head, and power consumption. Current, Voltage, Motor input Power, Frequency, Speed, Bearing/ Motor winding Temperature, Vibration and noise level of pumps and drives and parallel operation (as applicable) without hunting & abnormal noise and with load sharing within 10% of each other at the rated duty point of pumps shall be demonstrated at site as a part of Performance & Guarantee test.
- ii) Shop tests conducted with the actual motor shall be considered to determine the guaranteed performance parameters of Flow, Head, Efficiency and Power Consumption. During the shop test no negative tolerance in the guaranteed capacity, head and efficiency of the pump shall be allowed.
- iii) Detailed requirement of CW pump tests are mentioned in CW system specification.

11.34.12 Heat Exchangers

- i) Heat transfer coefficient determining the performance under design heat load and inlet & outlet temperatures of the heat exchangers on the primary and secondary side to be demonstrated at site.
- ii) Pressure drop across the heat exchanger on the primary and secondary water circuit to be demonstrated at site.

11.34.13 Clarifier

- i) Each clarifier shall be tested to demonstrate the effluent quality at the outlet of clarifiers at site under P&G test.
- ii) Satisfactory working of all the clarifiers, its drives, scrapper mechanism, operation of sludge blow-off etc, shall be demonstrated by Bidder

11.34.14 Filters

- i) Each filter shall be guaranteed for design capacity meeting the effluent quality with one backwash and air scouring (if applicable) in not less than 24 hours or more.
- ii) Backwash water quantity



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- iii) Outlet turbidity of each filter
- iv) Satisfactory working of all the filters, its backwashing operation, operation of various valves etc shall be demonstrated by Bidder.
- 11.34.15 DM Plant
- 11.34.16 Fire Protection System
 - i) Capacity, Head & Power consumption of fire water pumps. Shop tests will be acceptable.
- 11.34.17 Elevators
 - i) Carrying capacity of Elevators (kg)
 - ii) Over speed test
 - iii) Over load test
 - iv) Travel and hoist Speed Checks
 - v) Landing checks
- 11.34.18 Cranes and hoists in each area
 - i) EOT cranes
 - a) Safe working load (T)
 - b) Operating speed (meters per minute)
 - 1) Hoisting
 - 2) Long travel
 - 3) Cross travel
 - ii) Under-slung cranes
 - a) Safe working load (T)
 - b) Operating speed (meters per minute)
 - 1) Hoisting
 - 2) Long travel
 - 3) Cross travel
 - iii) Electric hoists
 - a) Safe working load (T)
 - b) Operating speed (meters per minute)
 - 1) Hoisting
 - 2) Long travel
- 11.34.19 Air conditioning system in each area
 - i) Capacity and discharge pressure of chilled water pumps, condenser waterpumps at its rated duty point. Parallel operation of pumps
 - ii) Capacity and static pressure of AHU fans at its rated duty point.



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LEAD TECHNICAL SPECIFICATION

REV. - A

- iii) Auxiliary power consumption
- iv) Inside room conditions during summer, for all air conditioned areas.
- v) Vibration and noise level of equipment.
- 11.34.20 Ventilation system in each area
 - i) Capacity and static pressure of centrifugal fans, roof exhausters at its rated duty point of Ventilation system.
 - ii) Auxiliary power consumption
 - iii) Inside room conditions
 - iv) Capacity and discharge pressure of pumps of air washer units and UAF units at its rated duty point of Ventilation system.
 - v) Vibration and noise level of equipment.
- 11.34.21 CW Chemical Treatment
 - i) The bidder shall guarantee that the program offered shall meet the performance requirements stipulated for CW System. Also, the bidder shall demonstrate the guaranteed chemical consumption proposed in the bid, during the contract period.
 - ii) For the purpose of verifying the guarantees on scale, a deposit monitor/test heat exchanger/fouling monitor shall be provided by the bidder stimulating the condenser operating conditions. The deposit monitor shall be weighed in new and clean condition and then weighed again on monthly basis and after completion of the test period. Prior to commencement of treatment program and after chemical cleaning of condenser tubes, the fouling factor shall be calculated for each condenser of 1 x 800 MW unit.
 - iii) The fouling factor shall also demonstrate the cleanliness of condenser tubes by visual examination of the same.
 - iv) Corrosion coupons reflecting the metallurgy of the system components shall be supplied and installed by the contractor to measure guaranteed corrosion value and corrosion rate shall be determined based on observations on monthly basis after completion of six months.
 - v) Guarantee Values of Scale, Corrosion, Fouling & Bio Fouling
 - a) Cumulative Corrosion Rate on Mild Steel < 3 mils/year
 - b) Cumulative Corrosion Rate on Stainless Steel < 0.1mils/year
 - c) Cumulative Corrosion Rate on Cu/Ni < 0.3 mils/year.
 - d) Cumulative Scaling Rate of Internal Tube Surface Area of Condenser<15mg/dm²/year
 - e) Fouling Factor: Deterioration in Heat Transfer Coefficient shall not be more than 5%of the original value just before commencement of the treatment program.
 - f) TVC (Total Viable Count) (Micro Biological Counts) < 1.2 x 100000 counts/ml of circulating water.



g) SRB (Sulphate Reducing Bacteria) <100 organisms/100 ml of circulating water.

vi) Dosing capacity of all dosing pumps shall be demonstrated.

11.34.22 Coal & Biomass Handling Plant

i) Capacity in T/Hr (equivalent to 100% of rated) of conveyor system including the intermediate equipments for each of the two parallel conveyor streams separately or any combination thereof to be tested in the following flow path operations.

a) Flow Path A (Direct Bunkering Stream)

1) From wagon tippler hopper discharge to crusher house and from crusher house to discharge of coal into last bunker through travelling tripper mounted on Bunker Conveyor including all intermediate Conveyors and equipments.

b) Flow Path B (Stacking Stream)

1) From wagon tippler hopper discharge to crusher house and from crusher house to stock yard using yard conveyor with stacker/reclaimer station farthest from yard conveyor tail end and boom conveyor at highest angle including all intermediate conveyors and equipments.

c) Flow Path C (Reclaiming Stream)

1) Reclaiming coal from stockyard using yard conveyor with stacker-reclaim rat farthest position from stacker conveyor head end, with the boom conveyor at its lowest position and feeding last bunker of through travelling tripper on bunker conveyor including all intermediate equipments.

d) Biomass stream flow path

1) Path – 1 (direct bunkering stream)

- From truck tippler hopper discharge to coal conveyor including all intermediate bucket elevator, conveyors and equipments for direct bunkering along with coal.

2) Path -2 (Stacking stream)

- From truck tippler hopper discharge to biomass storage shed through travelling plow for stacking of biomass mounted including all intermediate bucket elevator, conveyors and equipments.

3) Path -3 (Reclaiming stream)

- From Biomass storage shed scrapper cum spreader discharge to coal conveyor including all intermediate conveyors and equipments for direct bunkering of reclaimed biomass.

ii) Guaranteed tipping capacity of wagon tippler



iii) Guaranteed tipping capacity of truck tippler

iv) Guaranteed capacity of following equipments

- a) Apron Feeders
- b) Crushers
- c) Screens
- d) Stacker cum reclaimers
- e) Vibrating feeder
- f) Travelling trippers
- g) Bucket elevator

11.34.23 Ash handling system

i) Bottom Ash handling system

- a) Continuous effective extraction, crushing and conveying of bottom ash generated during various modes of boiler operation to the ash slurry sump and the continuous effective pumping of slurry from this sump to Dewatering Bins in stipulated time.
- b) Continuous effective extraction, crushing and conveying of bottom ash from Dewatering Bins to ART tank.
- c) Continuous effective conveying system shall be established by no stagnation of ash or slurry at any point in the complete system.
- d) Total time for evacuation of eight (08) hours of bottom ash collection in bottom ash hoppers per the technical specification.
- e) Bottom Ash belt conveyor capacity
- f) Bottom Ash vibrating feeder capacity

ii) Coarse Ash handling system

- a) Continuous effective extraction and conveying of economizer ash, APH ash and Duct ash from each economizer, APH and duct ash hopper to bottom ash hopper.
- b) Continuous effective conveying system shall be established by no stagnation of ash or slurry at any point in the complete system.

iii) Fly Ash handling system

- a) Continuous effective conveying of fly ash from all fly ash collection hoppers (ESP hoppers) generated during various modes of boiler operation up to buffer hoppers and from buffer hoppers to Fly ash silos in stipulated time.
- b) Continuous effective conveying of fly ash slurry from all the buffer hoppers to slurry sump in stipulated time.
- c) Continuous effective conveying system shall be established by no stagnation of ash at any point in the complete system.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- d) Total time for evacuation of eight (08) hours of bottom ash collection in bottom ash hoppers per the technical specification.
- e) Parameters of fluidizing air blowers, compressors, Air dryers and vacuum pumps including power consumption operating at the rated capacity and pressure tested at shop test
- iv) HCSD system
 - a) Continuous effective conveying of High concentration ash slurry from fly ash silo to ash dyke
 - b) Continuous effective conveying system shall be established by no stagnation of ash and ash slurry at any point in the complete system.
 - c) Rated capacity, head and power consumption at motor input terminal of each charge pumps and high concentration ash slurry disposal pump with correction for slurry density tested at shop.
- v) Slurry Pumps
 - a) Rated capacity, head and power consumption at motor input terminal of each ash slurry pumps with correction for slurry density tested at shop.
- 11.34.24 All Pumps otherwise elsewhere specified
 - i) Capacity, head, and power consumption of all the pumps at the rated duty point (to be demonstrated and proved at shop with the respective job motors) and to operate in accordance with the approved pump characteristic curves. During the shop test no negative tolerance in the guaranteed capacity, head and efficiency of the pump shall be allowed.
 - ii) Current, Voltage, Motor input Power, Frequency, Speed, Bearing/ Motor winding Temperature, Vibration and noise level of pumps and drives and parallel operation (as applicable) without hunting & abnormal noise and with load sharing within 10% of each other at the rated duty point of pumps shall be demonstrated at site as a part of Performance & Guarantee test.
- 11.34.25 Electrical system
 - i) As applicable and/or as specified in the technical specification in electrical Section
- 11.34.26 *Control and instrumentation*
 - i) Performance guarantee tests for closed loop control system shall be carried out at site to verify the integrated performance of the total plant C&I and to verify as to whether all the important parameters remain within stipulated permissible limits under all the operating conditions. In case during this tests or otherwise it is observed that the behaviour/response of Bidder's system (drives actuators/ valves etc.) is not satisfactory/acts as a limitation/restriction in achieving the permissible limits, the bidder shall carry out all required modifications rectification etc., in his system whatsoever so that the permissible limits can be achieved. He shall also depute his experts for associating in the above tests and also for carrying out the necessary modifications, rectification etc.
 - ii) Further the Performance guarantee tests shall be as applicable and/or as specified in the technical specification in Control & Instrumentation section.



11.34.27 Automatic on-line turbine testing (ATT) system

On-load testing of turbine protective equipment without disturbing normal operation and keeping all protective functions operative during the test

11.34.28 Make-up water

Bidder shall specify the amount of make-up water required at TMCR and the conditions being the basis for his calculation. Bidder will be required to guarantee the amount.

11.34.29 Vibrations

Bidder shall guarantee that the vibration levels as stipulated elsewhere in this specification will not be exceeded under any operating condition.

11.34.30 Plant Availability Guarantee

i) Bidder shall guarantee the availability of the plant as a whole to be demonstrated during the Warranty period.

ii) The availability shall be minimum 95%.

iii) Plant availability shall be calculated with reference to 100% TMCR and full 1 year operating period from the date of taking over of the plant. In case this is not achieved, such period shall be further extended to 1 year from the date of repair of the equipment.

iv) The availability of the plant shall be calculated as below:

$$\% \text{ Availability} = (\text{OT} + \text{IT})/8760$$

Where-

OT = Actual operating hours of the plant during the one (1) year period (8760 hours) starting from the date of Taking Over of the plant

IT = Time in hours when the plant may be idle in the one (1) year period (8760 hours) due to reasons not attributable to the Bidder.

v) Preventive and forced outages as well as capacity deratings done due to plant problems shall be considered.

vi) Planned maintenance including statutory inspection time shall be considered as plant available period.

vii) Outages and deratings due to dispatch conditions will not be considered in availability calculations (i.e. it will be considered that the plant is fully available during such dispatch conditions).

viii) Outages and deratings due to reasons not attributable to the bidder will be considered as fully available in availability calculations.

11.34.31 CONSUMABLES

i) Bidder shall specify the major consumables and their consumption. Bidder will be required to guarantee the consumption specified.

11.34.32 Other Guarantees



- i) Any other guarantee as applicable and/or as specified in the respective sections of the technical specifications
- 11.34.33 Performance Guarantee on Helical Springs and Viscous Dampers for Machine Foundations
- i) The Bidder shall guarantee the performance of the Steel Helical Springs and Viscous Dampers, to be provided by him for various machine foundations as specified in detailed technical specification, for a period of 24 months from the date of commissioning of each machine.
- ii) For TG foundation, TDBFP & MDBFP & PA/FD/ID Fan foundations, in case Open Foundations are adopted by the bidder, then bidder has to furnish extended warranty of Five Years for satisfactory Static & dynamic performance of the respective foundations.
- 11.34.34 Performance Guarantee on Acid / Alkali Resistant Linings & Anti-Weed Treatment
- i) The Bidder shall furnish a performance guarantee for the acid/ alkali resistant linings and anti-weed treatment, as specified in detailed technical specification, for a period of three years from the date of completion of work or date of handing over, whichever is later.
- 11.35.00 TURBINE GENERATOR PERFORMANCE ACCEPTANCE TEST
- 11.35.01 Performance test for the turbine generator set will be conducted in accordance with the latest edition of ASME PTC-6. Such test shall be binding on the parties to the contract to determine compliance with the guaranteed heat balance conditions at 840 MW (105% TMCR) MW, 800 MW (100% TMCR) & 440 MW (55% TMCR) unit outputs corresponding to the conditions stipulated in the specification.
- 11.35.02 Power consumed by the auxiliaries mentioned under in the Unit Heat Rate calculations, which is to be deducted from electrical power generated, shall be measured during the performance / Acceptance Test. Wherever the measurement is not possible, design values of power consumption by an auxiliary shall be considered.
- 11.35.03 Corrections to the test results for steam turbine shall be applied as per the correction curves listed in technical specification. All the efforts shall be made to control the unaccounted for leakage to the minimum, when the system is properly isolated for a performance test. It shall be bidder's responsibility to arrest all the cycle leakages and valves passing before start of initial operation. It will be endeavour of the bidder to keep the unaccounted for leakages below 0.1% of the design throttle flow at that load. In case the value of unaccounted for leakage, is more than 0.1% of design throttle flow at that load, the suitable correction for make-up shall be provided as per approved correction curve.
- 11.35.04 If due to any unavoidable situation, PG test is delayed, Ageing allowance will be given during evaluation of PG test results and hence guaranteed heat rates shall be increased by the amount calculated as per the formula given in Cl. No. 3.07, Sub-Section-3 of ASME-PTC-6 Report 1985 (Reaffirmed 1991). Period of ageing shall be considered from the date of successful completion of initial operation to the date of conductance of PG test, In calculating the above factor any period(s)



during which the turbine has not been in operation at a stretch for more than a week shall not be considered.

11.35.05 The tests shall be arranged in a manner that the OWNER's operation is not disrupted Duplicate test runs shall be performed at 840 MW, 800 MW and 440 MW unit loads. The results of corrected heat rate shall agree within 0.25%. If they differ by more than 0.25%, third test shall be run at the same point. The corrected result of any one of the three test runs, which deviates from the corrected averaged result of all the runs by more than 0.25%, shall be eliminated; otherwise the results of all the three tests runs shall be accepted.

11.36.00 The applicable values of liquidated damages factors for non- fulfilments of guaranteed performances are indicated under Volume-1, Commercial conditions of Contract.

12.00.00 SITE HEALTH AND SAFETY MANAGEMENT

12.01.00 Safety is to be given utmost priority. Safety is one of the most important philosophies to be strictly followed, while execution of this project. All precautions shall be taken by the bidder to avoid any unsafe incidents, including injury to personnel involved in installation of this project, material damage and environmental damage. Bidder will be completely responsible for any consequential damage arising out of such unsafe acts/incidents by the bidder or bidder's sub-contractor.

12.02.00 Bidder should follow all the safety regulations / norms as imposed by the Law/Authority/factory inspectorate /owner.

12.03.00 Bidder shall require his employees to wear suitable personal protection equipments (PPEs) like hard hats, safety shoes/boots and safety reflective jacket at all times when they are inside the plant area. Hard hats, safety shoes and safety jackets with reflective stripes shall be mandatory for all site personnel. Safety gumboots shall be used while working in waterlogged or slushy area.

12.04.00 All workers, when going to or from place of work in the plant only the prescribed walkways, paths or cross-overs shall be used. Rail-road crossing warnings shall be followed.

12.05.00 The bidder shall be responsible for:

12.05.01 The management of safety organisation at site for implementation of health and safety at site

12.05.02 The identification of site hazards and assessment of risks and mitigating the same

12.05.03 The arrangement of emergency plans, safety inspections and audits.

12.05.04 The system of notifying all employees, of the site safety plan, method statements and site safety rules.

12.05.05 Imparting safety induction training to all workers involved in the project, directly or indirectly under him.

12.05.06 Conducting safety review meetings



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 12.06.00 The bidder shall ensure the safety of all workmen, materials and equipment either belonging to him or to others working at site under him. He shall observe safety rules & codes applied by the Owner at site without exception.
- 12.07.00 The bidder shall notify the Owner of his intention to bring to the site any equipment or material which may create hazard. The Owner shall have the right to prescribe the conditions under which such equipment or material may be handled or prohibit the use of the same for safety reasons. Bidder shall abide by Owner's decision in such cases. No claim for compensation due to such prohibition will be entertained by the Owner.
- 12.08.00 Storage of petroleum products & explosives for construction work shall be as per rules and regulations laid down in Petroleum Act, Explosive Act and Petroleum and Carbide of Calcium Manual. Approvals as necessary from Chief Inspector of Explosives or other statutory authorities shall be the responsibility of the Bidder.
- 12.09.00 All requisite tests and inspection of handling equipment, lifting tools & tackle shall be periodically done by the Bidder and all records shall be maintained. Defective equipment shall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load.
- 12.10.00 All combustible waste and rubbish shall be collected and removed from the work site at least once each day. Use of undercoated canvas, paper, corrugated paper, fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed.
- 12.11.00 The bidder shall provide adequate number of fire protection equipment of the required types for his stores, office, temporary structures, labour colony, etc.
- 12.12.00 Personnel trained for fire fighting shall be made available by the Bidder at site during the entire period of the contract.
- 12.13.00 All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The Bidder shall maintain adequate number of qualified electricians to maintain his temporary electrical installation safely.
- 12.14.00 All accidents resulting in injury shall be reported to the Owner promptly. Owner's safety rules, regulations and directives shall be followed and reports thereon shall be submitted as and when required.
- 12.15.00 Female workers shall not be allowed to work beyond 6 PM.
- 12.16.00 The Bidder shall provide necessary first aid facilities for all his employees, representatives and workmen working at the Site. Enough number of Bidder's personnel shall be trained in administering first aid.
- 12.17.00 First aid kits shall be available at bidder's site office and other suitable locations.
- 12.18.00 Bidder shall ensure that proper treatment of injuries is immediately available either as such or in the form of constantly available transportation to a source of such treatment.
- 12.19.00 Bidder shall ensure that stretchers are available near all areas in which their men are working and that the location of stretchers are well marked.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 12.20.00 Bidder shall be solely responsible for the dissemination of all safety regulations including those written here, those promulgated by the Owner and those dictated by good practice, and shall ensure that all his employees and those of his Sub-Contractors are conversant with same.
- 12.21.00 Safety regulations during execution
- 12.21.01 Crawling on, over or under movable equipment shall generally be prohibited.
- 12.21.02 For overhead work, proper signs shall be placed below and shall be barricaded preferably, and, when conditions justify, a watchman shall be stationed to warn employees in the vicinity. Suitable safety nets shall also be used to avoid fall of men/material/tools.
- 12.21.03 Work on or about crane runways shall not be undertaken without the Owner's permission. Whenever it is necessary to do any work on or above the crane runways, the Bidder shall furnish a flag man stationed on the floor.
- 12.21.04 Scaffolding:
- i) Only scaffolds which meet the safety requirements and any governing laws shall be used in the project.
 - ii) All scaffoldings shall be certified by the safety inspector and shall be visibly tagged as per the status, whether it is UNSAFE or FIT for USE.
 - iii) Hand rails and toe guards shall be provided for all platforms unless unavoidable.
- 12.21.05 Work in area of electric wires and cables shall generally be avoided.
- 12.21.06 All burning and welding equipment shall conform to, and be used in accordance with, regulations governing such equipment. No burning or welding shall be done at any place on the site until location where such work is to be done is approved.
- 12.21.07 Adequate fire protection shall be made available before proceeding with such work.
- 12.21.08 Appropriate warning signs shall be placed at various locations and shall be observed.
- 12.21.09 Temporary guard rails/barricading shall be provided for all openings/pits during construction. And, safety belt, as required, depending on fall height, has to be used while working very near to such area.
- 12.21.10 Safety goggles shall be worn whenever there is a possibility of flying particles or splashing of corrosive fluid.
- 12.21.11 When working around corrosive environment workmen shall wear gloves, goggles and protective shoes.
- 12.21.12 When ladders are the means of access to a platform, they shall be firmly secured top and bottom and the ladder rails shall extend at least one meter above the top landing. When a ladder cannot be secured, a man shall be stationed at the base.
- 12.21.13 Safety belts shall be used by men working in high places above 6 feet, when no hand rails or other guards are in place. Fall arrester shall be used wherever required and as directed by owner's safety inspectors.
- 12.21.14 List of suggestive safety equipments is as below:



S. No.	Safety equipment
1.	Safety PPEs (Industrial Safety helmet & Industrial Safety Shoes) Industrial Safety Helmet (IS: 2925-1984 marked) Industrial Safety/Electrical Shoes (IS: 15298-2002 marked) Full body Safety Harness (conforming IS: 3521)
2.	Fall Arrestor 'Rope grab fall arrestor' &anchorage line. Anchorage Line: 14mm -16 mm diameter, three strand twisted Polyamide rope. Rope Grab fall arrestor: Open able& Guided type Fall Arrestor (on flexible line) conforming EN 353-2 & works on 14-16 mm diameter polyamide rope. material: Nickel Chrome plated Steel Connector: Karbiner conforming to EN 362 (Minimum Strength 22 KN), material: Steel
3.	Horizontal life line Stainless Steel Wire rope of 8mm diameter. Minimum six nos. of steel U-bolt clips are required for clamping each wire rope to a rigid support (03 nos. of U-bolt clips at each end).
	Safety Net (Conforming IS 11057:1984) Safety Net (Net Size: 10m x 5m, Mesh Size: 25 mm, Mesh Rope: 2mm double cord, Border/Tie Cord: 12mm diameter polypropylene rope (tested as per IS: 5175). 2M length shall be provided at all four corners.

13.00.00 SPARE PARTS

- 13.01.00 All the spares shall be delivered in new and unused condition.
- 13.02.00 All spares shall be procured from their OEMs or from equally reputed vendors.
- 13.03.00 Equipment and components shall be standardised as much as possible for interchange-ability and to reduce spares inventory.
- 13.04.00 Spares shall be inter-changeable with the parts for which they are intended to be a replacement.
- 13.05.00 The quality plan and the inspection requirement finalized for the main equipment will also be applicable to the corresponding spares.
- 13.06.00 All spares shall be properly packed and protected for long storage at site under prevailing conditions, upto expiry of guarantee period of the spares.
- 13.07.00 Spare part identification number shall be clearly marked for all items.
- 13.08.00 Spares for the plant shall be divided into three categories as follows:
- 13.08.01 Commissioning and start-up spares**
- 13.08.02 It shall be the responsibility of the bidder to maintain adequate items in sufficient number, as commissioning & start-up spares to ensure that commissioning& start-up activities and plant operation till end of Performance Guarantee Test and subsequent handover of the plant to owner, do not hamper for want of spares.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

13.08.03 These used spares shall be the property of the owner. However, bidder will be allowed to take back all the left over unused erection and commissioning spares after the guarantee period is over.

13.08.04 All commissioning & start-up spares as required shall be provided by the Bidder without any additional cost to the Owner.

13.08.05 The list and details of start-up and commissioning spares shall be furnished by Bidder prior to award of Contract.

13.09.00 Mandatory spares

13.09.01 The mandatory spares required for the plant are identified and listed in Annexure-3, Volume-Vof this specification. Bidder shall review the list of spares specified and finalise the same based on the equipment and system proposed by the Bidder, with the approval of Owner.

13.09.02 When a particular item of spares is indicated as 'percentage', it shall be considered as percentage of total number of that item for scope of work, unless specified otherwise. Fraction shall be rounded off to the next higher whole number.

13.10.00 The Bidder shall specify the quantity in numbers/sets, unit cost and anticipated normal life of individual spares. Wherever sets are mentioned, the bidder shall furnish the item details and prices of each such sub-item.

13.11.00 One set of spares for particular equipment shall mean the total quantities of that particular spares for the single equipment e.g., 'set' of bearings for a pump shall include the total number of bearings in a pump. The 'set' shall however, include all components required to replace the item of spares.

13.11.01 The owner reserves the right, to vary the quantity of any of the spares and /or to add/delete any item of spares, after evaluation/during award/detailed engineering stage limited to a period of six (6) months from date of award of contract, at the unit rates agreed to in the contract or to be mutually agreed at a later stage.

13.11.02 The deliveries of mandatory spares shall commence from the date of first synchronisation of the plant and shall be completed on or before the date of taking over the plant by the owner. However, imported spares may be supplied along with respective equipment.

13.12.00 Recommended operation and maintenance (O&M) spares

13.12.01 The bidder shall provide, based on his own experience of the performance of his equipment, in the form of a schedule given in bid documents, the complete list of recommended operation and maintenance spares for three (3) years operation of the equipment covered under the proposal.

13.12.02 Price of Recommended O&M spares will not be used for evaluation of the Bid.

13.12.03 In the list of operation and maintenance spares parts, the Bidder shall identify the unit-wise population of each of items recommended and anticipated normal life of the spares.

13.12.04 The spare parts must be able to replace the original part completely and have the same technical specifications in quality, material, inspection and mechanical aspects.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 13.12.05 Bidders shall supply all measurement testing data (if applicable) of any spare part supplied.
- 13.12.06 All spare parts supplied shall be packed and stored for a 5 years preservation based on the local climatic conditions. Suitable preserving coating as required shall be applied. Small spare parts shall be packed and sealed by transparent plastic bags and drying agents will be used if necessary.
- 13.12.07 Every spare parts shall have operation instructions and design marks of the factory when it is supplied.
- 13.12.08 When multiple spare parts are packed in one packing box or container, the general indication to the spare parts outside the packing boxes or containers shall include a detailed list. All packing boxes, containers, and other such tanks shall be marked properly and numbered clearly. All electrical equipment including switches, fuse connection easy melting and other similar apparatus shall be protected and insulated.
- 13.12.09 The identification of all spare parts shall be in the English language.
- 13.12.10 Deliveries of these spares (if awarded under this contract) shall commence within 6 months from the date of taking over of the plant by the owner and shall be completed within 12 months from the date of such taking over.
- 13.12.11 Wear and tear parts, to be replaced by the Owner at his own cost, shall be marked separately.
- 13.12.12 Bidder shall identify in the spare parts list, the items having a delivery time of more than 3 months
- 13.12.13 Bidder shall enter into a long term spare supply agreement with the OEM, and agree to transfer the same faithfully to the owner upon COD. Bidder shall commit to facilitate further negotiations on the spares with the OEMs directly by the owner.

14.00.00 TOOLS AND TACKLES

- 14.01.00 All tools and tackles required for repair and maintenance of the plant by the owner, after takeover shall be supplied by the bidder.
- 14.02.00 This shall also include special tools and tackles as required for the operation, maintenance, inspection and repair of the individual main equipment and auxiliary equipment shall be supplied by the Bidder in sufficient quantity to equip the shift personnel, maintenance personnel and workshop craftsman for commissioning, testing, calibration, modification and maintenance of the unit.
- 14.03.00 List of such special tools, tackles and equipment shall be submitted in the EPC bid.
- 14.04.00 The tools, tackles and appliances supplied in general, shall not be used for erection purposes by the Bidder and shall be handed over in brand new condition. Damaged tools, tackles, and appliances shall be replaced before handing over.
- 14.05.00 The exception to this is the special lifting gear which may be used provided that when it is handed over to the Owner it has not been subjected to more than normal wear and is still fully suitable for its intended use.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 14.06.00 The following tools and appliances shall be supplied under this Contract for use by the Owner:
- 14.06.01 Two sets of special tools and gauges required for the maintenance of the Plant
- 14.06.02 One set of special lifting and handling tackles / appliances required for the maintenance of the Plant.
- 14.07.00 Each set of tools, gauges and appliances under category (a) above shall be suitably arranged in fitted boxes of mild steel/aluminium/wooden construction, the number of boxes being determined in relation to the layout of the plant and equipment in question.
- 14.08.00 If the weight of any box and its contents should be such that it cannot conveniently be carried, it shall be supported on steerable rubber-tyred wheels.
- 14.09.00 Each cabinet and box shall be painted, fitted with a lock and clearly marked in white letters with the name of the item of equipment for which the tools and appliances contained are intended. Details of the tools/tackles and a list of items shall be maintained for each box and shall be marked on the box or a copy of list of items shall be maintained (tamper proof) in the box.
- 14.10.00 Suitable storage racks shall be provided for all portable tools and tackles supplied under this contract.
- 14.11.00 Suitable lifting lugs, ears or ring bolts, or tapped holes for lifting rings shall be provided on all equipment items where the weight exceeds 15 kg.
- 14.12.00 All lifting tackle shall be stamped with a unique identification number and safe working load. A test certificate from an approved Authority shall be supplied for each item of lifting tackle.
- 14.13.00 The Bidder shall provide a schedule of all lifting tackle and tools and appliances being supplied, for the approval of the Owner's Engineer.
- 14.14.00 The Bidder shall provide all runway beams, trolleys (manual as well as battery operated), mobile ladders, collapsible maintenance platforms, lifting blocks, special slings etc. necessary for the safe and efficient handling and maintenance of the works. Particular attention shall be paid to handling of equipment located at higher elevations
- 14.15.00 The tools and appliances with the appropriate storage racks, cabinets and boxes shall be handed over to the Owner at the time of Taking Over of the complete Plant.
- 15.00.00 CONSUMABLES**
- 15.01.00 Lubricants and greases**
- 15.01.01 All lubricants proposed for the Plant operation shall be suitable for all operating and environmental conditions that will be met on site.
- 15.01.02 All oils and greases shall as far as possible, be readily available in India.
- 15.01.03 The number of oils and greases shall be kept to a minimum. For each type and grade of lubricant recommended, the bidder shall list at least three equivalent lubricants manufactured by alternative companies.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 15.01.04 In case of imported oils, lubricants and other consumables, the bidder shall indicate the indigenous equivalents to enable the Owner to arrange subsequent refills. Preference should be given to indigenous oils and lubricants during first filling itself.
- 15.01.05 Short shelf life items if any may be supplied in a phased manner keeping in view of their actual use.
- 15.01.06 The Bidder shall supply the first fill of lubricants for the Plant, and shall provide at the Completion Certificate sufficient lubricants and greases necessary for the efficient operation and maintenance of the Plant at full load 24 hours per day for a period as specified under scope of supply.
- 15.02.00 Chemicals and other consumables**
- 15.02.01 Scope includes the supply (by the Bidder) of all chemicals, reagents, resins, and other consumables required for testing, commissioning and setting to work of each section of the Works.
- 15.02.02 The Bidder shall provide all chemicals and other consumables required for the efficient operation and maintenance of the plant at full load 24 hours per day for a period as specified under scope of supply and services.
- 15.02.03 The Bidder shall prepare a list of these consumables giving quantities necessary for each section of the works and the recommended suppliers.
- 16.00.00 SURFACE PREPARATION AND PAINTING**
- 16.01.00 This section covers the general requirements related to the cleaning protective coating and painting of equipment, components and system. Painting and protective coatings shall comply with the requirement of this section as well as Annexure-8, Volume-V, Painting requirements.
- 16.02.00 All paint and associated materials shall be procured from approved vendors and should be delivered to project site, in manufacturer's sealed original packaging/container. Each container shall be labelled by the manufacturer, with the manufacturer's name, type of paint, description of content, colour, batch number, date of manufacture, shelf life expiry date and pot life.
- 16.03.00 All coating materials and solvents shall be stored in the original container bearing the manufacturer's label and instructions.
- 16.04.00 The components and/or equipment shall be mechanically and /or chemically cleaned during the following stages-
- 16.04.01 Cleaning before painting and/or corrosion protection (application of prime coat)
- 16.04.02 Cleaning in workshop
- 16.04.03 Cleaning before erection and during installation.
- 16.05.00 Cleaning of fabricated component items shall be carried out after fabrication and final heat treatment or welding at manufacturer's works or at site, as appropriate.
- 16.06.00 For cleaning in workshop and before painting, mechanical cleaning as opposed to alternative chemical cleaning is the preferred method for works cleaning except where this is precluded by design or access considerations.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 16.07.00 Machined surfaces shall be protected during the cleaning operations.
- 16.08.00 In the event of the surfaces not being cleaned to the Owner's satisfaction, such parts of the cleaning procedures or agreed alternatives as are deemed necessary to overcome the deficiencies shall be carried out at the supplier's sole expense.
- 16.09.00 Austenitic stainless steels, copper and aluminium alloys, cast iron, bimetallic and metallic/plastic items, and components fabricated by spot welding or riveting shall not be chemically cleaned.
- 16.10.00 All weld areas shall be suitably stress relieved before chemical cleaning.
- 16.11.00 The paint manufacturer's instruction shall be followed as far as practicable at all times. Particular attention shall be paid to the following:
 - 16.11.01 Proper storage to avoid exposure as well as extremes of temperature
 - 16.11.02 Surface preparation prior to painting.
 - 16.11.03 Mixing and thinning
 - 16.11.04 Application of paints and the recommended limit on time intervals between coats.
 - 16.11.05 Shelf life for storage.
- 16.12.00 Any painting work (including surface preparation) on piping or equipment shall be commenced only after the system tests have been completed and clearance for taking up painting work is given by the Engineer, who may, however, at his discretion authorise in writing, the taking up of surface preparation or painting work in any specific location, even prior to completion of system test.
- 16.13.00 Mechanical mixing, as recommended by manufacturer, shall be used for paint mixing operations in case of two pack systems, except that the Engineer may allow the hand mixing of small quantities at his discretion.
- 16.14.00 All the surface preparation, protective coating, painting of steel, structures; equipments shall be suitable for prevailing site condition.
- 16.15.00 The bidder has to check all painting work to be carried out according to the specification & recommendations of the paint supplier, further to all relevant prescriptions and regulations concerning the health and safety of work.
- 16.16.00 The type and number of protective coats for any item requiring painting are to be furnished by the bidder as per the paint manufacturer's recommendation for owner's approval; if it is different from the requirements of the specification.
- 16.17.00 The paint supplier has to present data sheets including at least the flash point of the paints, ventilation requirements, handling precautions such as inhalation, eye and skin protection, and first aid procedure, storage requirements, spill or leak procedure, fire precaution, waste disposal.
- 16.18.00 Bidder shall take all safety precautions and shall follow the entire EHS requirement as agreed with the owner/engineer during execution of work.
- 16.19.00 The paint shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation which pertains to the work.



16.20.00 Protection of the blast cleaner operator's eyes and respiratory system should be given prime consideration in any open blast cleaning operation. Airfed helmets, respiratory filters, air conditioned hoods etc. should be provided in sufficient number to the blast cleaning operators to avoid the harmful effect of blast cleaning abrasives. Also, an automatic shut-off device which will shut-off the air supply to the blasting machine should be installed which will prevent the dangerous whipping of an operating blast hose if an operator becomes disabled.

16.21.00 The colour code scheme is intended for identification of the individual group of the pipeline. The system of colour coding consists of a ground colour and colour bands superimposed on it.

16.22.00 Transport and erection of painted structures shall be carried out only after the drying time specified by the paint manufacturer has elapsed. Handling & packing of painted material shall be appropriate to avoid damage to painting, such as the use of non-metallic slings, etc for handling and by minimising handling after painting. All steel equipment shall be provided with priming or coating system to protect the steel surface during transport, storage, installation and construction.

17.00.00 APPROVED SUB-VENDOR / MAKES

17.01.00 Approved sub-vendor list is provided in Annexure – 4, Volume-V.

17.02.00 Any change in sub-vendor/contractor for all items under this package shall be subject to owner's approval. Bidder shall submit all necessary credentials and other details as sought by owner for the approval of such sub-vendors.

17.03.00 Owner reserves the right to accept/reject any sub-vendor for the project.

17.04.00 Approval, rejection or addition of makes shall not have any cost implication to the Owner after award of contract.

18.00.00 PLANT AND EQUIPMENT IDENTIFICATION, LABELLING

18.01.00 Plant and equipment identification

18.01.01 The Bidder shall propose and apply a common identification system preferably KKS numbering for the whole plant equipment, facilities and systems showing the name and number of each item and its respective drawing number etc. to fully identify the plant.

18.01.02 The structure of the designations shall be developed in such a way that the symbols used can be handled by electronic data processing equipment. The identification system must be used by all subcontractors, vendors, etc., and shall be a proven system for power plant application.

18.01.03 Each item of plant shall be separately designed with a reference number, which shall be used consistently on the drawings, in the documents and on the catalogues as well as on the equipment items themselves.

18.02.00 Labelling

18.02.01 Name plates which are to be firmly fixed on all the equipment, buildings and structures shall be provided. For equipment of small size, these are to be fixed on the skid or structure adjacent to the equipment. The contents of nameplate are to include the designation and principal parameters of the equipment.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 18.02.02 The nameplate within the field shall be made of a high temperature - resistant metallic sheets, with designation permanently engraved on them.
- 18.02.03 Indoor installed equipments (e.g., panels, cabinets, switchgear, etc.) shall also be labelled by appropriate name plate.
- 18.02.04 The form, size, base colour and colour of contents of the name plates and prompting plates will be agreed between the Bidder and the Owner. It shall be possible for these to be readily seen by the operator. The designation of warning tags shall be different from that of other tags.
- 18.02.05 Each equipment/Piping service/Floors/Valves shall be marked with suitable font size/colour (Font colour shall be black) with florescent yellow colour and black border. Locations of labelling, font size/colour shall be decided / finalised by Owner.

19.00.00 DRAWINGS AND DOCUMENTS**19.01.00 General**

- 19.01.01 The bidder shall submit all design drawings and documents like, General Arrangement drawings, Mechanical, Electrical, C&I and Civil Design Basis/Criteria, Drawings, Data Sheets, Equipment and their Capacity Selection, Test Procedure etc. and other engineering documents stipulated in the specification for approval/information of the engineer along with the design calculations and general write up wherever involved. All design documents and drawings shall be properly coordinated.
- 19.01.02 The Owner reserves the right to ask the Bidder to submit copies of drawings and other documents for approval to his Head Office or to the Office of his Representatives. If the Owner/consultant are satisfied with the drawing, it will be returned to the Bidder marked with an 'Approved' stamp. If the Owner/consultant are not satisfied with the drawing, it will be returned to the Bidder with comments and the drawing shall be revised and re-submitted for approval.
- 19.01.03 The purpose of having drawings checked and approved by the Owner is to assist the Bidder in interpreting the Technical Specification so as to eliminate mistakes in the equipment or material actually shipped to the site of the work. The formal approval given to the Bidder is to be considered as in conformity with this purpose and in no manner shall be construed so as to release the Bidder from any liability or responsibility for proper design, fabrication or compliance with the Contract Documents.
- 19.01.04 Equipment drawings shall clearly indicate the general arrangement of the equipment to be furnished, give principal dimensions, and show sufficient details required for a complete power station.
- 19.01.05 While submitting drawings for approval, including any prepared by a Sub-Contractor, the Bidder shall certify that he has fully examined such drawings and that they comply with the requirements of the Contract.
- 19.01.06 For the purpose of this Clause, the term "drawings or documents" shall imply all design drawings and documents associated with the project including GA drawings, P&IDs, design calculations, data sheets, equipment specifications, design basis, diagrams, schedules, performance curves etc.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 19.01.07 Approval of a drawing by the Owner or his Representatives will imply that:
- Drawings and documents have been examined and appear to be in accordance with the basic design concept of the project and meet the requirements of the Specification.
 - Drawings and documents of components and equipment have only been examined in relation to compatibility of the items and equipment with the Specification and in respect of interconnection with other items and equipment.
 - Any approval given by the Owner or his Representatives shall in no way relieve the Bidder of his responsibility under the Contract.
- 19.01.08 The Owner will not normally require receiving copies of detailed manufacturing drawings but the Bidder shall make these available if requested to do so.
- 19.01.09 The Bidder shall ensure that drawings are submitted in due time to permit amendments to be made and the drawings re-submitted for approval without delaying the scheduled deliveries or the guaranteed competition dates according to the Contract. Execution of work shall be taken up after the drawings are cleared by the Owner.
- 19.01.10 Submission of drawings and documents for approval shall be strictly sequential, in accordance with the manufacturing and construction plan and sequence.
- 19.01.11 Master drawing list and submission sequence shall be submitted after approval of project schedule and supply schedule. Supply schedule shall include the lead time for manufacturing of all items.
- 19.01.12 It shall be noted that the tender drawings and data sheets submitted along with the specification is only for tender purpose and shows only the minimum requirements for the plant. Bidder's drawings and documents shall be more detailed and shall include all details as per the actual requirements during detailed engineering.
- 19.01.13 Requirements about the format of drawings and documents, the provision for documents and the Owner's responsibilities with regard to documentation are specified in relevant section of this volume.
- 19.01.14 Soft copies of all drawings and documents shall be submitted to owner and consultant via email and larger size files if any shall be transferred through Cloud Storage Servers. Sufficient soft copies as mutually agreed during the term of the contract shall be submitted in USB flash drive or SSD, especially as-built drawings and O&M manuals. Hard copies shall be submitted as per the document distribution schedule defined herein or as mutually agreed during the term of the contract.
- 19.01.15 The Bidder shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him, whether such drawings and particulars have been approved by the Owner and his Representatives or not.
- 19.01.16 The stipulations and requirements specified elsewhere in the specification shall also be followed with respect to preparation and submission of drawings.



19.01.17 All Bidder's drawings which are found to be incorrect during the construction period or which require changes owing to site constraints, shall be corrected by the Bidder to an "as built" condition to reflect any necessary changes.

19.02.00 Drawings and documents to be submitted by bidder

The drawings and documents to be submitted by the Bidder for approval shall cover the complete Scope of Contract work as defined by the Contract Specification and shall generally include, but not be limited to, the following:

19.02.01 *Drawings and documents to be submitted along with the bid:*

i) General

- a) Completely filled in technical schedules & other schedules as required to be submitted with the bid documents.
- b) Completely filled in data sheet – B
- c) Project milestone schedule
- d) Project implementation schedule (Level-2) along with required readiness dates for owner inputs and readiness of systems to be covered under Balance of Plant package.
- e) Inputs required from client, with quantities and qualities required.
- f) Sequential supply schedule of all major items, along with lead time for manufacture and delivery to site.
- g) Master Document List (MDL) for Mechanical, Electrical, Civil and C&I with sequential schedule of submission
- h) Project execution methodology
- i) Flow Diagrams and P&ID (Process and Instrumentation drawings) indicating Instruments and the destination / functionality of the signals
- j) Space requirement for construction site and equipment
- k) Layout of temporary site facilities, buildings, structures, installations
- l) Plot plan
- m) A report on foundation proposed for various structures, buildings and facilities based on the data furnished by OWNER and further data collected by the BIDDER. Allowable safe bearing capacity for open foundation, depth of foundation, need for pile foundations, soil improvement if any required, special precaution against aggressive soil etc., shall also be covered in the report.
- n) General arrangement drawings with sections for major building viz. Power house building, Boiler and auxiliaries, ESP & FGD control building, CW pump house, etc.
- o) Quality Assurance plan.
- p) Complete description of the plant offered including description of the process and the equipment



- q) General descriptions of individual systems and control philosophy including descriptions of operation including description of start-up, shutdown and emergency shutdown procedures, Also behaviour of boiler/steam generator and, turbine, etc. under transient conditions.
- r) Complete bill of materials of the plant with expected life of major items along with break up price
- s) Project specific Safety Plan shall be submitted for approval of owner.
- t) Training program and schedule for training of Owner's personnel
- u) List of spares
- v) List of Special tools and Tackles
- w) Maintenance proposal (for SG and STG)
- x) Inspection intervals (major/minor) for six years along with the spares to be replaced during the above inspections. Bidder shall provide the cost of such spares on yearly basis.
- y) For, steam turbine, steam generator, generator and the total scope of supply maintenance and overhaul charts should be submitted with this bid. Both major and minor plant outages for inspection and/or routine maintenance should be shown on the chart, together with the nature of the work to be undertaken and the expected duration of the outage. This information should also include all the auxiliary plant to be supplied under the Contract.
- z) Drawings and documents to be submitted with bid as mentioned elsewhere in the specification

ii) Mechanical

- a) Heat and Mass balance diagram same for 100% TMCR condition (0% and 1.0 % makeup), VWO condition (0% and 1.0 % makeup), 60% TMCR (Constant and Sliding pressure operation), All HP heaters out condition, Auxiliary steam condition and house load operation with HP-LP bypass in operation
- b) Start up curve for cold, warm and hot condition

iii) Electrical

- a) Technical description of electrical system
- b) Single line diagram of complete plant and auxiliaries
- c) Single line diagram of 400KV GIS switchyard
- d) Ratings of all major equipment - load list
- e) Characteristic curves of Generator& motors
- f) Description of Generator Cooling System, Excitation System & AVR
- g) GA drawing for all the major equipment such as Generator, transformers, GCB, HT switchboards



- h) Type test certificates for Generator, Generator transformer, GCB, HT switchboard
- i) Description & Catalogues of all Electrical equipment
- j) Technical Data Sheets
- k) Tentative layouts of switchyard and transformers.
- iv) Control and instrumentation
 - a) DCS / PLC architecture drawing (also indicating interconnection of different offsite C&I System) highlighting system features and capabilities
 - b) Plant Control and operational philosophy
 - c) Process description / functional write – up for all open loop and closed loop controls
 - d) GA diagram of the major equipments such control panel, control room console etc
 - e) Functional specification for Plant DCS, STG control system with technical catalogues
 - f) Write-up, scheme, technical details etc. of Continuous Emission Monitoring (CEM), Vibration monitoring and analysis system, Steam & Water Analysis System (SWAS), GPS /Master slave clock system etc
 - g) SER / Annunciation system configuration details including capacity, time stamping etc
 - h) Details on all C&I items including CCTV, AAQMS, lab Instruments, Flue gas analysers and Field Instruments
 - i) List of software (latest version) and hardware with confirmation certificate

19.02.02 Drawings and documents to be submitted after award of contract:

The drawings and documents required for design, manufacture, construction, installation, operation and maintenance of the plant shall be submitted by the bidder in good time for approval/information, so as to permit the plant as a whole to be constructed in compliance with the specification and time schedule.

The below list is only indicative. The detailed list and approval category of the drawings/documents shall be submitted and agreed sufficiently in advance, so that corrections and amendments desired by the owner as well as resubmission of the documents will not result in any delay with respect to the guaranteed time table. The owner reserves the right to request from the bidder additional drawings and documents as may be required for proper understanding and clarity on design and engineering of the plant.

- i) Re-Submission of all the technical data furnished during pre award contract stage.
- ii) Geotechnical investigation report
- iii) General arrangement drawings /Equipment layout of all equipments/buildings etc, along with coordinates, sections indicating the approach, unloading & maintenance area.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- iv) Bill of quantities/materials
- v) Part lists
- vi) Specifications
- vii) Design basis for all the systems and major equipment
- viii) Control philosophies
- ix) Design/Sizing calculation of all major equipment
- x) P&ID (Process and Instrumentation drawings) indicating Instruments and the interlocks for all the systems
- xi) Flow diagrams
- xii) Schematic diagrams
- xiii) System architectures
- xiv) Logic diagrams
- xv) I/O lists
- xvi) HMI configurations
- xvii) Data sheets of all items
- xviii) Load lists
- xix) Feeder lists
- xx) Drive lists
- xxi) Air requirement
- xxii) Water requirement
- xxiii) Ash collection data
- xxiv) Performance data
- xxv) Valve schedules
- xxvi) Pipe schedules
- xxvii) Pipe routing
- xxviii) Cable schedules
- xxix) Cable routing
- xxx) Cable connection diagrams
- xxxi) Settings
- xxxii) Instrument schedules
- xxxiii) Performance curves
- xxxiv) Single line diagrams
- xxxv) Key diagrams
- xxxvi) Circuit diagrams



- xxxvii) Protection schemes
- xxxviii) Load details
- xxxix) Forces, moments and movement diagrams
- xl) Design basis memorandum for all buildings, facilities, services and structures
- xli) Design calculations and drawings for foundations, substructure and superstructure of all buildings and other structures & facilities like drains, roads, crossings, tanks, sumps, trenches, ducts, sewers, tunnels etc.
- xl ii) Design calculations including dynamic analysis and drawings for all foundations subjected to dynamic loads like foundations for TG, BFP, Mill, Fans (PA, FD, ID), Crushers etc
- xl iii) Design calculations and drawings for all facilities and services like roads, culverts, bridges, paving, road/rail crossings, drainage pump house (if required), drains, sewers, sewage pump house, sewage treatment plant, water supply, water tank, sumps, tunnels, trenches, ducts etc
- xl iv) Architectural drawings including finishing schedules and colour schemes
- xl v) Foundation plans
- xl vi) Levelling and grading plan
- xl vii) Excavation details
- xl viii) Reinforcement details
- xl ix) Architecture details including schedule of doors and windows
- l) Plot plan of the site including all buildings and installations, roads, drains, pipe and cable rack/pedestal/ trench routing, sewage and fire system pipe line layout, storage and fabrication area etc with coordinates of major points and elevations/FGLs.
- li) Manufacturing quality plans for all items
- lii) Painting and surface preparation procedure
- liii) Painting schedules
- liv) Storage and preservation procedures
- lv) All field quality plans
- lvi) Welding procedures
- lvii) Equipment testing procedure
- lviii) Equipment and system wise commissioning procedures
- lix) Monthly progress reports
- lx) Master document list
- lxi) Manufacturing and supply/delivery schedule
- lxii) L2 network schedule
- lxiii) System wise L3 schedule



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- lxiv) Testing reports
- lxv) Declaration of confirmation with statutory regulations
- lxvi) Operation and maintenance manuals
- lxvii) Lubrications list and schedule for all items
- lxviii) All as built drawings
- lxix) Training program
- lxx) Complete bill of materials of the plant with expected life of major items along with break up price
- lxxi) Piping isometrics drawings along with hanger's details & Bill of Materials.
- lxxii) Drawings and documents as mentioned elsewhere in the specification and as required by the owner for better understanding or other reasonable purpose, even though not specifically mentioned.

19.03.00 Document distribution schedule (of Hard copies, after placement of order)

Document	Distribution		
	Owner		Consultant
	Head Quarter	Site	
L2 schedule & monthly progress reports	4	4	0
Drawings and documents for approval	3	0	0
Drawings and documents for information	3	0	0
Approved drawings and documents	2	2	0
Testing and commissioning procedures	2	2	0
O&M Manuals	2	4	0
As built drawings	2	4	0

Note: Only soft copies to be submitted to consultant. However, hardcopies should be submitted to consultant, whenever specifically sought.

19.04.00 Manuals

19.04.01 General

- i) The Bidder shall provide the manuals in a timely manner to enable the Owner / Engineer to review and comments and request changes as necessary.
- ii) Payments will be withheld for non-compliance or for late delivery of the drawings, procedures and manuals. In particular the Bidder shall be held responsible for



consequential damage to the plant where such damage is due to late delivery of the O&M manual resulting in non-familiarity of the operating technique.

- iii) The Bidder shall also note that while all documents, procedures and manuals shall be in the English language including that of the sub vender of the bidder, it is particularly important that the O&M manuals be in clear concise English.
- iv) All manuals shall be divided by systems or sections and cross-indexed as necessary.

19.04.02 Certification Manuals

- i) This manual shall contain the approved works certification documentation for all plant equipment and services as specified in the relevant codes and standards and in this specification and the Bidders Quality Manual.
- ii) This manual shall also include all material tests certificates. Certificates and test procedures shall be specific to the plant supplied.

19.04.03 Construction Manual

- i) This manual shall include a comprehensive record of as built site construction tests and records.
- ii) The manuals shall be compiled in separate parts system wise for the complete plant offered.

19.04.04 Commissioning Manual

- i) This manual shall include all the records, certificates and test results arising from the agreed pre-commissioning and commissioning procedures carried out on site.
- ii) The performance tests and guarantee test results shall also be included. There is a particular requirement that all commissioned plant/equipment values be recorded in this manual and subsequently incorporated into the O&M manuals.

19.04.05 Operating and Maintenance (O&M) Manual

- i) The Bidder shall provide the O&M Manual properly bound, within the time required/specified, to enable the Owner's staff to become fully acquainted with the operation, adjustment and maintenance of the entire plant.
- ii) The manuals shall contain full and explicit instructions in respect of the operation of the plant under all operating conditions and the maintenance routines and requirements to be established to maintain the plant in optimum performance.
- iii) These instructions shall be as comprehensive as possible and the form in which they are to be set out shall be agreed with the Owner / Engineer.
- iv) The instructions shall be tailored to suit the specific requirements of the Operations and Maintenance functions and personnel, taking into account the staffing philosophy for the thermal power project.
- v) The instructions for the related parts shall be accurate and easy to understand and shall contain the necessary sequence of individual activities.
- vi) The diagram and drawings associated with the instruction shall be clear and unambiguous.



- vii) It is an essential requirement that all information and plant data contained in the manual must be project specific and derived from the design, manufacturers / suppliers and commissioning data of the as-built plant.
- viii) Where the Bidder includes standard brochures the installed item of plant or equipment shall be clearly identified.
- ix) All sections shall contain an introductory description of the particular item/system including its function and operating criteria and any special features.
- x) On the basis of the commissioning and running experience of the Plant, the instructions shall be amended to a final form within three months of the end of commissioning and, for this purpose; the Bidder shall supply the required number of printed copies of all approved amendments for insertion in the bound set of instructions.
- xi) The Bidder shall prepare manuals integrating all equipments supplied by the sub vendors.
- xii) The entire O&M manuals including that of the sub vendors shall all adopt the same format paper size etc.
- xiii) Contents of the Manual (equipment or system wise)
 - a) Safety precautions
 - b) Write-up/specification of the equipment/system
 - c) Control philosophy
 - d) Installation instructions
 - e) Commissioning instructions
 - f) Operation instructions
 - g) Maintenance instructions
 - h) Data Sheets
 - i) General arrangement drawings, P&IDs, schematics, wiring diagrams, logics, functional diagrams, performance curves etc.
- xiv) Manuals may be common or separate for-
 - a) Erection/installation
 - b) Operation &
 - c) Maintenance
 - d) Equipment Preservation/Storage instruction
- xv) Operating Instructions
The instructions shall include at least the following specific procedures/items:
 - a) Pre-start-up
 - b) Start-up
 - c) Normal operation and parameters to be monitored and limiting values



- d) Shut-down
- e) Interlocks and protections
- f) Operation procedures during fault conditions
- g) Trouble shooting
- h) Isolation procedures
- i) Stand-by mode and preservation
- j) Operation Logs/running records to be maintained including parameters and intervals
- k) Items requiring special attention (if any)
- xvi) Maintenance instructions
 - a) Maintenance instructions shall include the required inputs for-
 - 1) Mechanical
 - 2) Electrical
 - 3) Control and instrumentation
 - b) The instructions shall include at least the following specific procedures/items:
 - 1) Safety instructions
 - 2) Inspection
 - 3) Handling and lifting
 - 4) Routine maintenance and intervals
 - 5) Lubrication schedules and lubricants
 - 6) Assembly and disassembly
 - 7) Part lists including part identification number and blow-up diagrams
 - 8) Drawings detailing tolerances
 - 9) Set-up and calibration
 - 10) Test-run
 - 11) Special maintenance/repair including welding (if any)
 - 12) Maintenance log and history to be maintained
 - 13) Items requiring special attention (if any)

19.04.06 Plant Technical Diary

- i) A plant technical diary including technical details of all plant systems and equipment shall be prepared and submitted.
- ii) The technical diary shall include following details as a minimum:
 - a) Major specifications
 - b) Location



- c) Make
- d) Quantities
- e) Weight
- f) Material of construction
- g) Bearing details
- h) Major dimensions
- i) Design and working pressures
- j) Efficiency

iii) All major technical parameters including limiting values shall be specified therein.

19.05.00 Format

19.05.01 All drawings and documents shall be prepared in international 'A' series i.e. A4, A3, A2, A1 & A0

19.05.02 Soft copy of all documents shall be submitted in PDF format. AutoCAD or other original formats may be sought by owner/consultant in some cases like plot plan for better clarity/understanding.

19.05.03 Grouped documents shall be provided by size A4, with the inclusion of bigger size drawings which, however, have to be folded as Size A4.

19.06.00 Numbering and Identification of Documents

19.06.01 All the drawings shall be identified through a common way of numbering in accordance with the requirement of contracting.

19.06.02 The numbering system of drawings and documents proposed by the Bidder shall be in compliance with the plant identification system and to be agreed with the Owner.

19.06.03 Apart from this, some drawings may also be numbered in the way which the bidder or subcontractors are used to do. But, there shall be a common title block on all published drawings which include the following contents:

- i) Project
- ii) Owner
- iii) Owner's Engineer
- iv) Contractor
- v) Description
- vi) Drawing No.
- vii) Sheet No.
- viii) Revision No.

19.06.04 The measuring units and dimensions marked on the project engineering drawings shall be of SI system conforming to ISO 80000-1.

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

19.06.05 In case dimensions are not marked in conformity with the scale of drawings and any dimension on the drawing does not conform to those dimensions and sizes measured through certain scale, the actual marked dimensions shall be applicable.

19.06.06 For revision of drawings, the revised part shall be clearly and definitely shown on the drawing.

19.07.00 Others

19.07.01 The Owner and bidder agree that the Contract will be concluded in accordance with the EPC method of building the power project.

19.07.02 It is the Bidder's duty to ensure that design standards and conditions meet the requirements and that the power project shall operate safely, reliably and with high efficiency, having the same performance as stipulated and guaranteed.

19.07.03 The Owner may examine, check and approve the drawings and documents at his discretion with the aim of ascertaining that all these drawings and documents meet the requirements specified in the contract documents. The Bidder shall have an active and cooperative working relationship with the Owner. If there is a disagreement over any issue, Owner and Bidder shall work together to reach some conclusion through mutual consultations.

19.07.04 The drawings and documents of the Bidder shall be approved or returned with observations, within fourteen working days by the owner.

19.07.05 To enable smooth review of drawings and documents in time, bidder shall strictly follow the agreed document submission schedule and dumping/bunching of documents will not be entertained.

19.07.06 The Bidder shall clarify the observations raised by the owner and shall attempt to correct the drawing or document subsequently only.

19.07.07 Generally, copies of drawings or documents containing trade secret and drawings with patented nature need not be provided. However, to know whether the Bidder has performed its obligations, the Owner/consultant will have the right to examine those drawings and may seek them if required.

20.00.00 ENVIRONMENTAL PROTECTION

20.01.00 The Bidder shall offer a plant so as to meet the pollution control requirements of statutory authorities. Emissions and discharges of solid, liquid and gaseous effluents from the plant shall fully comply with all requirements and limits specified in Environmental (Protection) Act, 1986, along with all latest amendments to all of the above requirements, stipulations of the Central Pollution Control Board (CPCB), Ministry of Environment and Forests (MOEF) and State Pollution Control Board (SPCB) for the project, and any other central or local statutory requirements regarding environmental pollution and its abatement.

20.02.00 The discharge of pollutants in water and air as well as noise levels shall meet with the stipulations of Central Pollution Control Board (CPCB), Gujarat Pollution Control Board (MPCB) as well as other Acts of the Government under the Ministry of Environment and Forestry (MoEF). If there should be a discrepancy



between standards and this specification from the more stringent requirement will apply.

- 20.03.00 Bidder shall comply with the following clearances obtained for the project, as applicable for the scope of the package:
- 20.03.01 Environmental Clearance form MoEF
- 20.03.02 Consent to establish from MPCB
- 20.04.00 Environmental protection design for the power project will be based on the requirements of environmental impact report and relevant stipulations, and state of the art, proven technology will be adopted.
- 20.05.00 The air emissions of the plant will meet the Pollution control board norms and guidelines. The plant effluent shall also meet the stipulations laid down by Pollution control board. The general pollution control board (PCB) requirements shall be imposed. Any add-on requirements during public hearing and EC shall be imposed as amendment.
- 20.06.00 The plant should be designed to economize on water use and to set up a water management system featuring maximum reuse of effluents.
- 20.07.00 The Bidder shall take all necessary measures for noise attenuation in order to meet the specified noise levels. All equipment shall be designed to run without undue vibration and with the least amount of noise.
- 20.08.00 Six (6) nos. of environmental monitoring stations shall be provided by the EPC Bidder in accordance with "Environmental Protection Design Stipulation for Thermal Power Projects". It shall be provided with the instruments according to Environmental Monitoring norms to supervise and monitor the pollutants emitted during power generation so that it meets with the ambient air quality standards and also that environmental quality and trend can be known so as to provide scientific basis for pollution prevention and control. The environmental monitoring station will be designed in such a way as requiring no staff and Gujrat Pollution Control Board should be consulted in deciding the location of the stations.
- 20.09.00 In order to meet the environmental quality requirements, the Bidder has to guarantee that at all loads and operating conditions of the Steam Generator the flue gas emission levels (Suspended Particulate Matter (SPM), Sulphur Di Oxide, and NO_x) for the range of fuel to be used in the plant, will strictly adhere to the norms and requirements of MoEF. No deviation/correction in this regard is acceptable.
- 20.10.00 The Bidder shall provide on-line automatic Continuous Stack Emission Monitoring (CEM) for monitoring the levels of SO_x, NO_x and SPM. The Bidder shall also provide stack monitoring kits for monitoring SO_x, NO_x and SPM at plant boundaries.
- 20.11.00 The monitoring systems should incorporate the means to record various time averaged values as required by the performance requirements. Monitoring data should be displayed in the control room, with provision of alarms to notify the operator of any deviation from the specified values. The Bidder shall furnish a list of monitoring equipment he intends to provide with their location in the plant.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- 20.12.00 Soil can become contaminated by oil and chemical spillage during Operation and Maintenance of the Plant. The entire plant shall be designed, operated and maintained in such a way to prevent any soil contamination and adequate provisions shall be made in the design.
- 20.13.00 Dust emission to the air from the site, roadway, etc. shall be controlled by providing suitable dust control systems.
- 20.14.00 Noise Control
- 20.14.01 An integrated approach shall be taken by the Bidder to control noise emission which shall include but not be limited to:
- i) Design and layout of building to minimise transmission of noise, segregation of particular items of plant and to avoid reverberant areas
 - ii) Specification of permissible noise levels for bought-out items
 - iii) Choice of materials for civil construction
 - iv) Acoustic design of buildings
 - v) Use of acoustic lagging / enclosure with attenuation properties on plant components/installation of sound attenuation panels around the equipment.
- 20.14.02 Where the requirements stated above are not met within the basic design of the plant they shall be achieved by the supply under the Contract of suitable means of noise control, which shall conform to the following requirements:
- i) The noise control system shall, as far as possible, be designed to form an integral part of the plant
 - ii) The abatement system shall, wherever practicable, be applied to the source of excessive noise rather than to the entire item or component
 - iii) If above means are not adequate and enclosures are used for noise abatement, close fitting enclosures shall be provided
- 20.14.03 Noise control areas
- i) Control Rooms - The noise levels in control rooms must be such that intelligible speech communication is always possible and mental concentration is not hindered.
 - ii) Other control areas - The noise levels in other control areas must be such that intelligible conversation (telephone and person-to-person) is possible and operator fatigue is minimised.
 - iii) Station noise criterion - The criterion for environmental noise is that the design of the station and its components shall not exceed, in any continuous mode of operation, the level stipulated by MOEF and/or Pollution Control Board at any point on the site boundary. Presently the norm is such that the noise level shall not exceed 85 dBA at 1.5 m from equipment surface and 70 dBA at plant boundary.
 - iv) Noise level shall not exceed 85 dBA at 1.5 m from equipment surface, except for the following:
 - a) Turbine, generator and pulveriser – 90dBA

**GUJARAT STATE ELECTRICITY CORPORATION LIMITED**

VOLUME - II

**1x800 MW ULTRA SUPERCRITICAL UNIT NO. #7ON ASH DYKE
AREA AT UKAI TPS**

SECTION - 2

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

LEAD TECHNICAL SPECIFICATION

REV. - A

- b) Safety valves & associated vent pipes, HP/LP bypass valve, soot blower or wall blowers, regulation drain valves – 115 dBA

20.15.00 Adequate plantation shall be provided along the periphery and in the power project to satisfy the norms and stipulation as laid down by the Govt. of Gujarat and MoEFCC, Govt. of India.

20.16.00 The rain water collected from the roof of buildings shall be channalised through the rain water down comers and routed to the garland drain around the buildings. These garland drains shall be connected to the plant storm water drainage network system all around the plant. Several recharge wells shall be located at strategic locations within the plant and shall be interconnected to the storm water drain network system to ensure recharging of the ground water table.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

**1X800 MW ULTRA SUPER CRITICAL UNIT No. # 7
ON ASH DYKE AREA AT UKAI TPS**

BID DOCUMENT

FOR

EPC CONTRACT

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT# 7-TS-01

VOLUME - III

PART - A

SECTION -1

**STEAM GENERATOR & AUX. INCLUDING DE-NOX SYSTEM AND MILL REJECT
HANDLING SYSTEM**

STEAG Energy Services India Pvt. Ltd.
(A wholly owned subsidiary of STEAG Group, Germany)
A-29, Sector-16, NOIDA-201301, India



GUJARAT STATE ELECTRICITY COPRORATION LIMITED
1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS
 BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01
 TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
 INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
 SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
 MRHS

VOLUME - III
 PART - A
 SECTION - 1
 REV. - 0

INDEX

VOLUME	PART	SECTION	
I	A		COMMERCIAL
		1	NOTICE INVITING BIDS (NIB)
		2	INSTRUCTION TO BIDDERS
		3	GENERAL CONDITIONS (GC)
		4	SPECIAL CONDITIONS FOR ERECTION & CONSTRUCTION
	B		QUALIFICATION REQUIREMENT
	C		SCHEDULES
		SCHEDULE- 1	PRICE SCHEDULE – SUPPLY
		SCHEDULE- 2	PRICESCHEDULE–SERVICES
		SCHEDULE- 3	PRICE SCHEDULE - SPARES
		SCHEDULE- 4	PRICE SCHEDULE - TOOLS AND TACKLE
		SCHEDULE- 5	FORMATOFMONTHLYCASHFLOWCHART
		SCHEDULE- 6	SUPPLIMENTARY TECHNICAL SCHEDULE
		SCHEDULE- 7	DECLARATION SHEET
	D		GUARANTEE SCHEDULE
	E		BID FORMS
II			GENERAL
		1	PROJECT INFORMATION
		2	LEAD TECHNICAL SPECIFICATION
III			DETAILED TECHNICAL SPECIFICATION
	A		MECHANICAL
		1	STEAM GENERATOR & AUX. INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING SYSTEM



GUJARAT STATE ELECTRICITY COPRORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

		2	STEAM TURBINE AND AUXILIARIES
		3	ASH HANDLING SYSTEM
		4	MATERIAL HANDLING SYSTEM
		5	PLANT WATER SYSTEM
		6	PIPING, VALAVES & SPECIALITIES AND THERMAL INSULATION
		7	FGD, LIME HANDLING SYSTEM & CHIMNEY
		8	COOLING WATER & AUXILIARY COOLING WATER SYSTEM
		9	COMPRESSED AIR SYSTEM
		10	AIR CONDITIONING AND VENTILATION SYSTEM
		11	FIRE PROTECTION AND DETECTION SYSTEM
		12	GAS CYLINDERS
		13	CRANES AND HOISTS
		14	NATURAL DRAFT COOLING TOWER
		15	ELEVATORS
		16	AUXILIAY BOILERS
	B		ELECTRICAL
		1	ELECTRICAL TECHNICAL SPECIFICATION
		2	TECHNICAL SPECIFICATION COMMUNICATION EQUIPMENT AND OPGW (24F & 48F DWSM)
	C		CONTROL & INSTRUMENTATION
	D		CIVIL, STRUCTURAL AND ARCHITECTURAL
IV			BID DRAWINGS



GUJARAT STATE ELECTRICITY COPRORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

V			ANNEXURE
		1	PLOT PLAN
		2	DATA SHEET-B (TO BE FILLED BY BIDDER)
		3	MANDATORY SPARES LIST
		4	SUB-VENDOR LIST
		5	GEOTECHNICAL SURVEY REPORT
		6	TOPOGRAPHY SURVEY REPORT AND DRAWING
		7	ENVIRONMENTAL CLEARANCE
		8	PAINTING REQUIREMENTS
VI			AMENDMENTS

	GUJARAT STATE ELECTRICITY COPORATION LIMITED	VOLUME - III
	1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE AREA AT UKAI TPS	PART - A
	BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01	SECTION - 1
	TECHNICAL SPECIFICATION STEAM GENERATOR & AUX. INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx & MRHS	REV. - 0

VOLUME - III, PART - A

SECTION - 1

TECHNICAL SPECIFICATION

MECHANICAL

STEAM GENERATOR & AUXILIARIES, ESP, DeNOx & MRHS

PREPARED BY



(An ISO 9001:2015 certified Company)

STEAG Energy Services India Pvt. Ltd.

(A wholly owned subsidiary of STEAG Group, Germany)

A-29, Sector - 16, NOIDA-201301, India

JANUARY, 2024



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

**TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS**

REV. - 0

TABLE CONTENTS

SUB SECTIONS	PAGE
1.00.00 GENERAL	2
2.00.00 BOILER & AUXILIARIES	2
3.00.00 DE-NOX SYSTEM (SCR)	46
4.00.00 DUST PRECIPITATION AND COLLECTION SYSTEM (ELECTROSTATIC PRECIPITATOR) - ESP	52
5.00.00 MILL REJECT SYSTEM	57
6.00.00 SPECIAL TOOLS & TACKLES AND TEST / MEASURING EQUIPMENTS	61
7.00.00 DATA SHEETS – A.....	63



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

1.00.00 GENERAL

1.01.00 This section covers minimum requirements for design, engineering, manufacture & assembly, inspection, supply, erection, testing commissioning and performance testing of complete Boiler & Auxiliaries for 1x 800 MW pulverized fuel based thermal power plant; to meet well established engineering practices, safety codes and other relevant codes and standards. This section will cover the following:

1.01.01 Steam Generator (SG) / Boiler

1.01.02 Electrostatic Precipitator (ESP)

1.01.03 Selective Catalytic Reduction (SCR)

1.01.04 Mill Reject Handling System (MRHS)

1.02.00 Bidder has to consider all guidelines issued by CEA & Other statutory bodies while designing the all systems.

1.03.00 Bidder has to take all required statutory approval for all systems.

2.00.00 BOILER & AUXILIARIES

2.01.00 The requirements mentioned herein shall be complied for the most stringent conditions specified i.e. with worst coal and operating conditions like 100% BMCR or HP heaters out of operation etc, unless, specified otherwise.

2.02.00 One (01) numbers of once through, single pass (tower type) or double (two pass) type using either spiral wall (inclined) or vertical plain/rifled type water wall tubing, single reheat, radiant furnace, dry bottom, balanced draft, pulverised coal fired steam generating unit having supercritical steam parameters with all necessary auxiliaries, integral piping, elevators, etc.

2.03.00 The evaporator of Steam Generator shall be once-through type suitable for variable pressure operation from sub-critical to supercritical pressure range,

2.04.00 The steam generators shall be designed for maximum continuous rating (BMCR capacity) and for the limiting parameters specified in the specification.

2.05.00 The steam generators and their auxiliaries shall be designed for outdoor installation.

2.06.00 The steam generator unit shall be capable of operating on sliding pressure mode. The load range for the sliding pressure unit operation shall be from 35% turbine generator maximum continuous rating (TMCR) to 90 % TMCR, and constant pressure mode operation between 90% TGMCR to 100% BMCR.

2.07.00 Steam generator shall be designed to meet the Indian Boiler Regulations (IBR). Any deviation from IBR shall be specifically approved by Purchaser and Boiler Inspector.

2.08.00 The technical requirement shall be complied with most stringent conditions resulting burning range of coals and range of operating conditions like 100% BMCR, HP heaters out of service, sliding pressure operation etc.

2.09.00 The bidder shall conduct necessary model test/study for the ducting and ESP from the air-heater outlet upto chimney inlet to finalise the layout of ducting and location and number of the flow splitters, guide vanes etc. The ducting layout shall be finalised



based on the results of the above model test and all the flow splitters, guide vanes etc. their supply and installation as required on the basis of ESP Model Test results.

2.10.00 Start up vents shall be provided with two valve in series-one motorized isolating and other motorized regulating type.

2.11.00 Steam Generator Rating

Boiler maximum continuous rating (BMCR)	Steam flow at superheater outlet shall be the maximum value between (a) 102% of the main steam flow at turbine inlet under VWO (Valves wide Open) with 0% make up, design CW inlet condition and (b) 2425 TPH whichever is higher.
Steam Temperature	
At Super Heater outlet	To achieve turbine throttle main steam temperature, as mentioned in the STG section. However, it shall be maximum 3°C higher than the rated steam temperature at inlet of HP turbine.(Refer – Vol.-III, Part-A, Section -2)
At Reheater outlet	To achieve reheat steam temperature, as mentioned in the STG section.. However, it shall be maximum 3°C higher than the rated main-steam temperature at inlet of IP turbine. (Refer – Vol.-III, Part-A, Section -2)
Temperature control	The steam temperatures at superheater and reheater outlet(s) shall be guaranteed to be maintained at +/-5°C of the rated value at all loads within control range (50% TMCR to 100% BMCR), under all operating conditions when firing specified range of coals.
Feed water temperature at economizer inlet	To be based on the turbine cycle optimisation, but not more than 305 °C. The steam generator shall also be suitable for accepting feed water at low temperatures corresponding to HP heaters out of service condition without exceeding any of its design limits including design metal temperature
Steam Pressure	
At superheater outlet	To achieve turbine throttle steam pressure, as mentioned in the STG section i.e. turbine rated steam pressure at ESV inlet plus pressure drop in HP steam piping. However, it shall be limited to maximum 3.5% of the rated main-steam pressure at inlet of HP turbine inlet. (Refer – Vol.-III, Part-A, Section -2)
At reheater outlet	Bidder to optimise pressure drop in Reheaters, including CRH & HRH piping, under all operating conditions. However, total pressure drop in reheat system shall not be more than 7.5% of the steam pressure at HP turbine exhaust.
Steam generator control range	50% TMCR to 100% BMCR. Under this control range, the steam temperatures at SH & RH outlets shall be maintained at their rated values. However, the bidder to specify the feasible mill combinations below 60% TMCR.
Efficiency of Steam Generator	The guaranteed efficiency shall be based Heat Input GCV of as received coal and other conditions such as design ambient temperature, relative humidity etc.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

2.12.00 Fuel

2.12.01 COAL

- i) 100% indigenous Coal.
- ii) The steam Generator shall be designed for the range of coals as specified in the Project Information (Refer – Vol.-II, Section-1).
- iii) The Steam Generator shall be designed to give the maximum efficiency when firing the coal having the characteristics for Design coal as specified in the Project Information.
- iv) The Steam Generator and its auxiliaries shall also be capable of obtaining the boiler maximum continuous rating (BMCR) when firing the coal having the characteristics for worst coal as specified in the Project Information.
- v) Blended Coal –
 - a) 70% : 30% indigenous & imported coal
 - b) Steam Generator and its auxiliaries shall also be capable of obtaining maximum continuous rating, safely and on sustained basis, when firing up to 30% imported coal, typical data of which is as specified in the Project Information; by weight blended with Indian coal(s) as specified in therein.
- vi) The equipment/ systems shall not exceed their safety limits under above-described firing conditions, and shall not transgress into factors of safety as per specification/ codes. Further during this firing, there shall not be slagging / clinkering phenomena and any hot spot in the pulverized coal system /pulverisers etc.

2.12.02 OIL

- i) LDO system to cater up to 30% BMCR requirements, without any coal firing.
- ii) The characteristics of Light diesel oil (LDO) are specified in the Project Information (Refer – Vol.-II, Section-1).
- iii) LDO shall be used for start-up, coal flame stabilisation and low load operation of the steam generators at load $\leq$ 30% BMCR.
- iv) Design and construction of the boiler shall be suitable for firing the fuel oils (LDO) mentioned herein, for continuous operation.
- v) The fuel oil requirements for steam generator shall be drawn from, existing LDO storage tanks as well as one no. new tank of 500 KL capacity shall be provided in the existing storage area. Existing LDO unloading system shall be connected to this new tank. Fuel from the existing storage tanks and new tank will be transferred to the LDO day tank by LDO transfer pumps to be provided by the Bidder. The fuel oil pressurizing and firing system shall be in the scope of Bidder. Bidder shall include all required piping, valves, fittings, instrumentation etc. upto the terminal point.
- vi) The design and construction of the steam generator shall be such as not to call for any other liquid or gaseous fuel other than that specified for purpose of operation of the steam generator at low load including initial ignition.
- vii) High energy arc (HEI) igniters shall be used for ignition of LDO fuel oil directly.



2.12.03 BIOMASS

- i) Also, Steam Generator shall be capable of firing 90% : 10%, indigenous coal & biomass

2.13.00 Limiting Parameters for Steam Generator Design

2.13.01 The Steam Generator design shall comply with the following limiting parameters with 'design coal' firing, under stipulated ambient air condition as specified in General Technical Specification.

1.	Excess air at economiser outlet at Turbine Maximum Continuous Rating (TMCR) (800 MW) load	20% (maximum)
2.	Flue gas temperature at air-heater outlet (corrected) at TMCR (800 MW) load	125 deg. C (Minimum)
3.	Heat Loss due to un-burnt carbon in ash (weight basis) at all loads with Fly Ash (FA) and Bottom Ash (BA) proportion of 80%:20%.	1.5% weight basis for FA and 0.25% weight basis for BA

2.13.02 The Steam Generator design shall comply with the Power Plant Flexible Operation as specified in General Technical Specification.

- i) The minimum rate of loading or unloading for coal based supercritical units shall be 3% per minute above the MPL. Bidder to indicate the maximum ramp-up rate can be responded by the boiler turbine system without appreciable loss of life.
- ii) Minimum Power Level (MPL) means the minimum output power at the generator terminals that the power plant can sustain continuously without oil support, which shall be 35% of TMCR which is equivalent to 30% of BMCR.

2.14.00 Boiler Design

2.14.01 The Bidder shall size each heat transfer bank and select their disposition along the gas path in the radiant and convective zone so that steam temperatures are maintained at stipulated levels within the control range with minimum spray water and minimum metal temperatures.

2.14.02 Bidder shall take care in their design the uniform gas energy distribution across a plane perpendicular to gas flow direction so as to ensure minimum deviation between left and right side steam temperatures. Left and right side imbalance of steam temperature shall be limited to 10 °C and 15 °C, for main steam and reheat steam respectively. To this effect, the Bidder shall provide in the design basis the segmentation of heat duty among different heating segments viz. economizer, water walls, different super-heater segments and reheater segments for ensuring required steam generator performance, under all operating conditions. The Bidder shall also furnish flue gas and water-steam temperature plot (showing left and right side values at each plane) to indicate heat pick up indifferent heat transfer banks and differences. The plot will include spray water and metal temperatures at different sections along the gas path for clean tube and dirty tube conditions.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 2.14.03 The contractor shall demonstrate steam temperature imbalance across two sides (LHS and RHS) as mentioned above during commissioning. In case the temperature difference between the two sides of more than as mentioned is observed beyond reasonable extent, the contractor shall provide necessary arrangements (as required) without any extra cost implication to GSECL.
- 2.14.04 Further the considerations for thermo-hydraulic design of the evaporator and mechanical design of the water walls as well as selections pertaining to the off take point to separator and the location of intermediate headers (if applicable) shall be clearly defined and brought out in the Technical datasheet. These shall include the limiting values of degree of superheat of steam (at minimum circulation flow and other loads), tube to tube temperature differentials at the evaporator outlet, tube (thickness/inner diameter/roughness) selection, furnace heat flux considerations and the cyclic loading and start-stop requirement that are specified in the specification.
- 2.14.05 Two nos pressure gauge of having range 0-400 kg/cm² and minimum diameter of 300mm shall be provided and necessary arrangement shall also to be provided at each separator.
- 2.15.00 **Steam Generator Structure**
- 2.15.01 The steam generator structure shall be designed to support all loads located on the structure including the load transferred from the furnace buck stays seismic and wind loads. In addition, other loadings may be introduced on the structure from piping, enclosures, adjacent structures and equipment. Loading due to wind and seismic condition shall be computed based on IS: 875 and IS: 1893 respectively.
- 2.16.00 **Design of Pressure Parts**
- 2.16.01 The design of all pressure parts (tubes, headers, vessels etc.) shall be as per IBR or other international codes with the approval of the Owner.
- 2.16.02 Design pressure of the Steam Generator pressure parts shall be at least 1.05 times the maximum operating pressure, or as required by IBR/ other international codes, whichever is higher. Further, maximum operating pressure for design of the steam generator parts up to separator(s) inlet shall be arrived at by adding an additional margin for the increased pressure drop in the evaporator tubing due to scaling during operation over a period of time. This additional margin shall be equal to at least 2% of maximum operating pressure with evaporator tubing without scaling or actual expected increase in the pressure drop in water wall/ evaporator section, whichever is higher.
- 2.16.03 The thickness of the pressure parts (steam and water tubes/ headers, pressure vessels etc.) shall be calculated using IBR formulae/factor of safety etc. (and not as per codes/ formulae non acceptable to IBR). Such thickness as per IBR formulae shall be arrived at after allowing for tube bend thinning allowance, where applicable as per IBR/ international codes; Minimum tube thickness at the bends in no case shall be less than the minimum tube thickness for the straight tubes.. Additional allowance for erosion and loss of materials due to mechanical working, on the calculated tube thickness shall be provided at specified locations as specified in these specifications.
- 2.16.04 In line with IBR, the maximum permissible temperature/ metal temperature for design of different components of the Steam Generator shall be considered as specified in the Data Sheet-A.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 2.16.05 Materials used for Steam Generator tubing, headers, piping, vessels and other pressure parts shall comply with maximum permissible temperature limits for various materials as specified in the Data Sheet-A.
- 2.16.06 The working fluid temperature to be considered for design of pressure part tubes starting from water wall bottom ring header upto and including the water wall outlet headers shall be arrived by adding an additional margin of minimum 50 °C to the maximum predicted/expected fluid temperature in these pressure parts/ wall tubes considering part of the furnace wall acts as radiant superheater.
- 2.16.07 The working fluid temperature to be considered for design of pressure parts starting from downstream of water wall outlet headers upto first stage of superheater attemperation shall be arrived by adding an additional margin of minimum 39 °C to the maximum predicted/expected fluid temperature in these pressure parts.
- 2.16.08 The margins as per IBR and other codes shall be taken over and above the working fluid temperatures so arrived.
- 2.16.09 For the other pressure parts where no design margin is specified in the IBR and the above specified 50°C or 39 °C margin is not applicable, the working fluid temperature to be considered for design of pressure parts shall be arrived at by adding following margin to the maximum predicted/expected fluid temperature in these pressure parts:
- 10 °C for inlet headers and its connecting tubes, pipes downstream and upstream of attemperators and other pipes in pressure parts.
 - 15 °C for outlet headers and their connecting tubes except at final super heater and final reheater outlet.
 - For final super heater and final reheater outlet and piping, a minimum margin of 8 °C and 15 °C shall be considered.
- 2.16.10 It is however, the responsibility of the Bidder to get various calculations and other technical documentations approved by the statutory authorities in the state and country of location of the plant.
- 2.16.11 Permanent facility for steam blowing line tapping with necessary valves of suitable size for Main Steam Line (except start-up vent) shall be provided
- 2.17.00 **Furnace**
- 2.17.01 The furnace shall be designed such that the heat release rates shall not exceed the values specified in Data Sheet-A, at 100% BMCR condition. The distance between centre line of bottom most coal burner and furnace hopper working point shall be not less than 3 meters. The configuration of the furnace shall be such that flame impingement on any section of the furnace is avoided over the entire load range.
- 2.17.02 ASLD system to detect Steam Leakage & High temperature CCTV system for monitoring furnace flame viewing to be provided.
- 2.17.03 The furnace shall be designed for a pressure as indicated in Data sheet-A, to withstand pressure regimes without permanent deformations. The furnace shall be made of gas tight welded membrane walls and the tube panels bent, where required for openings of wall blowers, observation ports, access doors and instruments. To minimize the wear of membrane walls, geometry that causes notch effect shall be avoided.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 2.17.04 The furnace walls shall be either spiral wound and vertical tubes or vertical rifle tubes, as per the manufacturer's practice. Bending radius for tubes shall be as large as possible and minimum 1.5 times of external diameter. Provided thickness of tubes shall have sufficient margin over the calculated minimum thickness value as per IBR to account for erosion and corrosion, thinning due to bending, loss of materials due to mechanical working. An additional thickness of 1.5 mm shall be provided for the wall up to separator storage tank level.
- 2.17.05 The furnace shall have hopper bottom with stainless steel seal plates suitable for connection to ash hopper. A suitable sealing arrangement shall be provided for connecting to water impounded dry bottom ash system. The clear width of the hopper throat shall not be less than 1100mm. The height of furnace bottom shall be adequate from the ground level depending on the hopper volume requirement and for accommodating bottom ash handling system.
- 2.17.06 All openings of wall blowers, observation ports, access doors and instruments shall be designed to prevent infiltration of air into the unit.
- 2.17.07 Space provision for at least 20% addition of additional economizer and 10% for the reheater surfaces in future shall be provided. The surface provisioning shall be flue gas upstream section of the economizer. Structure/hanger design shall be suitable for loads due to these additional surfaces (filled with water) also.
- 2.17.08 Bottom inclined part of membrane wall/ casing for the flue gas path (after furnace exit) between furnace rear wall screen tubes and back pass front wall screen tubes shall be inclines at an angle more than 45 degree so that ash accumulation is prevented. Additionally, suitable number of LRSBs shall be provided to clean the deposited ash. This portion of the duct shall be provided with additional erosion protection by means of Cr₃C₂NiCr or equivalent spray coating.
- 2.17.09 Dissimilar Metal Welds (DMW) between martensitic and austenitic steels, martensitic and ferrite steel shall be avoided inside the boiler enclosure for the pressure parts, which are exposed to hot flue gases. However, if such DMW are unavoidable, same can be permitted at shop provided manufacturer has previous experience of such DMW and appropriate heat treatment is done after welding.
- 2.18.00 **Casing**
- 2.18.01 A gas tight enclosure shall be designed for the entire steam generator from the lower furnace to the economiser exit. In areas where welded wall construction is used, no skin casing is required, but skin casing of steel plates shall be used for all enclosures and behind all wide spaced tubes where refractory is used.
- 2.18.02 Steam Generator enclosed shall form air/gas tight envelope from secondary air and primary air inlet point to chimney inlet.
- 2.18.03 The enclosure shall be formed using welded wall construction only. Where use of refractory is unavoidable, 4mm thick steel plate behind refractory shall be provided to form enclosure.
- 2.18.04 Steam Generator casing/pent house (as applicable) shall be provided. The casing/penthouse design shall ensure:



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- i) Complete enclosure of Steam Generator including superheater, reheater & economizer headers.
- ii) The casing/pent house and its supporting system shall be capable of taking additional loads due to accumulations of ash upto 300 mm height or actual expected (in between two overhauls of the units), whichever is higher. This additional load is over and above other loads considered for casing design. The ash density for the purpose of ash loading shall be at least 1300 kg/m³.
- iii) Temperature upset due to maximum gas temperature variation across furnace shall be considered while selecting pressure parts materials

2.18.05 Steam Generator casing/pent house shall:

- i) Form rigid self containing structure, with adequate stiffening.
- ii) Be welded wall construction, sectionalized to allow easy removal/replacement of casing/penthouse wall sections.
- iii) Be weatherproof and water tight construction for protection from monsoon rains/winds.
- iv) Have all drainage arrangement like gutters, drain pipes etc., connected to plant drainage system at ground level.
- v) Be provided with boiler roof arrangement of proven design & architecture. The boiler main roof arrangement shall be provided with monitor for ventilation and light. The overlap between the monitor and the main roof should be such that it prevents ingress of rain to the steam generator casing/penthouse. The boiler roof shall be extended downwards all around the boiler to a level of atleast 2 meters below the penthouse casing roof. Suitable ventilation provision shall be provided in these side walls. All necessary sealing collars/wall boxes shall be provided where the pipes pass through the boiler roof or its extended side walls.

2.18.06 Frames shall be furnished around all openings in the steam generator.

2.18.07 The thermal insulation and lagging shall be provided for all the equipment/plant for the conservation of heat, maintenance of operating temperatures and protection of the personnel.

2.18.08 In the Steam Generator enclosure, minimum 1.5 m cavity height shall be provided in between the horizontal banks/sections of economizer, super-heater and re-heaters for maintenance purpose.

2.18.09 The boiler enclosure shall be provided with:

- i) Observation ports for each oil/coal burner and at various platform levels, on all the walls. Cooling of observation ports shall be provided.
- ii) Opening with hinged doors (air/gas tight) in all areas needing access for internal observation/maintenance. Provide minimum two openings for each area.
- iii) Approach platform for each observation port/opening.
- iv) Seal plates of stainless steel (type 430) or better corrosion and erosion resistant steel material of minimum 6.00 mm thickness, all round the furnace bottom, to prevent ingress of air.

2.18.10 The pent house shall be provided with suitable ventilation system or cooling fans etc.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

2.19.00 Furnace Wall Evaporator and Steam System

- 2.19.01 The system shall be designed for a continuous operating capability as specified in Data Sheet-A. Bidder shall clearly bring out the design features that individual evaporator tubes to have uniform temperature distribution, to minimize the peak tube metal temperature, unit temperature variation between adjacent enclosure tubes and prevent departure from nucleate boiling in evaporator sections.
- 2.19.02 The furnace wall system shall be of materials specified in the Data Sheet-A. The Bidder shall enclose a calculation sheet for tubes, pipes and headers, stating dimensions, material, tolerance, design pressure and design temperature, design tension, operating pressure and operating temperature as well as fatigue factors and necessary wall thickness.
- 2.19.03 Water/steam walls shall be of membrane wall construction and shall be made of seamless cold drawn tubes. Furnace / evaporator shall be formed using spiral wound / inclined tubing or vertical plain / rifled tubing as per the proven practice of the manufacturer for boilers of similar capacity.
- 2.19.04 The furnace wall system shall be made of seamless tubes.
- 2.19.05 A careful and safe fixing and suspension of tubes and tube banks shall be available to prevent misalignment and rubbing during operation. Design details shall be included in the Bid document.
- 2.19.06 Suitable allowances shall be provided for all the steam and water- tubes to counter the erosion conditions.
- 2.19.07 The furnace support system shall be so designed to transfer the weight of the entire furnace to the structural steel so as to accommodate inherent movement and expansions during operation without imposing any constraints.
- 2.19.08 Further, construction of furnace walls shall in no way create differential thermal expansion on the furnace wall tubes. The Bidders shall furnish details of furnace support system including systems of transfer of furnace wall loads and construction of steam generator support system in his bid.
- 2.19.09 The furnace walls shall be equipped with buck stays arranged at suitable spacing to take up the forces due to positive and negative gas pressure expansions. The furnace buck stays design pressure shall be as specified in Data Sheet-A. Suitable wear bars shall be provided above the furnace bottom hopper to avoid tube leakages because of falling of slag.
- 2.19.10 Irrespective of the type of water wall tubing offered for the evaporator, the design offered shall ensure that no readjustment of tube mass flow is required during entire operating regime of the Steam Generator for complete range of specified coals. In case such readjustment becomes necessary over a period of five years from the date of successful completion of initial operation of respective Steam Generator, the cost of carrying out such flow readjustment/modifications including cost towards rectifying any damages to the Steam Generator tubing resulting from the inappropriate mass flow in the tubes shall be borne by the Bidder. Bidder in his proposal shall indicate the approximate time required for such readjustment of tube mass flow and the period of unit shut down.



- 2.19.11 The thermo-hydraulic design of the offered evaporator shall be stable under varying heat flux and mass flux conditions as well as other system disturbance that the evaporator may encounter during operation. The stability of the thermo-hydraulic design of the evaporator shall be demonstrated by the bidder by conducting stability analysis (both static and dynamic) of the finalized evaporator design. As a part of the static stability, interalia, the outlet temperature profile for each tube at the intermediate header inlet (if applicable) and vertical wall outlet header be calculated. The variance of tube outlet temperature shall be validated by carrying out site demonstration for the first boiler during commissioning by affixing metal temperature thermocouples at each evaporator outlet tube (at intermediate header inlet, if applicable and vertical wall outlet). These thermocouples shall be over and above the requirements for metal temperature thermocouples specified elsewhere. In case the temperature variance in the evaporator tubing temperature during such demonstration is found to exceed the design considerations necessary modifications to the evaporator flow circuits shall be done by the Bidder to control the tube temperatures.
- 2.19.12 The mechanical design of the evaporator shall be carried out considering its primary stresses due to internal pressure as well as secondary stresses due to loads like weight membrane panel, buckstays, ash, and other elements loaded on evaporator, differential stresses restrained thermal expansion between evaporator tubes and the evaporator support elements etc. The calculations in support of the same shall be submitted by the Bidder.
- 2.19.13 Also at outlet of transition/intermediate header, bidder has to provide forged elbows to give safe end.
- 2.19.14 Flame impingement on steam/water walls is not permitted. Suitable provisions, including the extent of combustion staging, shall be made to minimize the water wall corrosion. The bidder shall demonstrate that the average thinning of tubes in the burner zone due to corrosion, erosion etc. shall not be more than 0.1 mm/per year.
- 2.19.15 Headers shall be located external to gas path and shall be completely drainable. If locating headers in gas path becomes unavoidable, then suitable erosion shields must be provided.
- 2.19.16 For, vertical tubing arrangement, Minimum 10 mm dia. Wear bars of suitable wear resistant material shall be welded along the full length of first 40 tubes of inclined water wall tubes of S-panel of bottom hopper from each corner up to hopper opening.
- 2.19.17 In case of spiral tube arrangement, wear bars shall be welded on each of the inclined water wall tubes of S-panel up to a length of 3.3 m from each corner. Alternatively, instead of welding wear bars to the inclined wall tubes as indicated above, in order to take care of tube erosion due to sliding ash, Bidder can also provide 1.0mm additional tube thickness on entire inclined tubes of the 'S' panel over and above the tube thickness calculated as per IBR and other specified requirements.
- 2.19.18 Provision for future installation of additional Soot Blowers shall be made in the furnace. Necessary space provision in layout for providing approach and platform for future soot blowers shall be kept in the original design itself so that same can be installed whenever the future soot blowers are required. The loads for these platforms shall be considered in the boiler structure design. In case of such a necessity of installation of

	GUJARAT STATE ELECTRICITY COPORATION LIMITED	VOLUME - III
	1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE AREA AT UKAI TPS	PART - A
	BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01	SECTION - 1
	TECHNICAL SPECIFICATION STEAM GENERATOR & AUX. INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx & MRHS	REV. - 0

additional soot blowers, the Bidder shall install these soot blowers and associated access and platforms without any cost implication to the Employer.

- 2.19.19 Erosion resistant shields for tubes/header affected by gas impingement/laning effects (e.g. in a between SH/RH, Economizer and furnace walls openings for economizer bypass etc.)
- 2.19.20 Erosion resistant shield (SS 304, thickness 3mm, hardness minimum 180 HB) shall be provided for all headers installed in second pass and its inlet/outlet horizontal tubings.
- 2.19.21 Tapping points at five levels for furnace vacuum monitoring (in addition to routine monitoring).
- 2.19.22 All round seal plates of stainless steel type 430 or better (6-mm thick minimum) welded to furnace hopper for sealing against air ingress.
- 2.19.23 Corrosion resistant shields/coating for tubes/header affected by splashing of water from bottom ash hopper, due to fall of ash clinkers.
- 2.19.24 Panel to panel welding in burner zone to be avoided to maximum possible extent. Profile shields/ erosion prevention measure to be provided on top and bottom burner panel bends.
- 2.19.25 Furnace pressure transmitters shall be provided at both front & rear bottom of S-panel (Left & Right Sides).
- 2.19.26 Provide stainless steel expansion markers/indicator on all the four furnace walls to monitor thermal expansion. Predicted thermal expansion at different levels to be indicated. In addition to local indicators, measurement system (4-20mA Output) for remote indication shall also be provided on all the four furnace walls.
- 2.19.27 For continuous monitoring of water wall tube metal temperatures provide 100 numbers of thermocouples outside the gas path as per specification specified elsewhere in the Technical Specification.
- 2.19.28 The exact location and number of thermocouples shall be finalized during contract stage. However, Bidder shall furnish unit rates for addition/deletion of the thermocouples with respect to the numbers mentioned above.
- 2.19.29 Alarm set point for tube metal temperature shall not exceed the design temperature of respective tube.
- 2.19.30 Suitable temperature monitoring system consisting of 80 nos. of thermocouples should be provided for Bottom hopper, Pent House, Economizer, SCR hoppers, APH hopper etc. The exact location and number of thermocouples shall be finalized during contract stage. However, Bidder shall furnish unit rates for addition/deletion of the thermocouples with respect to the numbers mentioned above.
- 2.19.31 Insulation skin temperature measuring system consisting of 40 nos. of thermocouples to be provided in critical areas like Burner panel and critical piping areas. The exact location and number of thermocouples shall be finalized during contract stage. However, Bidder shall furnish unit rates for addition/deletion of the thermocouples with respect to the numbers mentioned above.



2.20.00 Separators, Storage Tank and Circulating Pumps

2.20.01 Steam separators along with a drain collection vessel at the evaporator outlet. The separator(s) and drain collection vessel shall be of welded construction/ seamless tube with all its internals, safety valves, mountings, fittings and accessories including the nozzle for connections and service manholes for checking and maintenance, necessary tapping points along with root valves for level measurement, drains, valves, piping and associated fittings.

2.20.02 A water-steam separator system shall be provided with an adequately dimensioned collecting vessels and cyclone separators for use during steam generator start- up and low loads.

2.20.03 1x100% start-up drain recirculation pump or boiler circulating water (BCW) pumps complete with connecting pipe work between separator/drain collection vessel and the pump and between pump and the feed water supply pipeline along with necessary separator/drain collection vessel level control and isolation valves.

2.20.04 Double isolation (one motorised and one manual) valve at the suction and Motorised isolation, Electro-hydraulic operated control valve and a non return valve on the discharge of the pump.Also, Motor operated inching type bypass valve of discharge flow control valve shall be provided.

2.20.05 A mixing box on the pump suction, a non return valve and motorized isolation valve upstream of the mixing box on the recirculation line from separator. Piping between the mixing box and the feed water supply line with a NRV on this line shall be provided. Other proven standard systems with start-up drain circulation pumps are also acceptable provided Bidder has proven experience on satisfactory performance of such system(s) in sub critical/supercritical units of similar capacity which are designed for variable pressure operation. In case Bidder offers start up circulation system without mixing box, the Bidder in his bid proposal shall furnish necessary data/information in support of provenness of system offered.

2.20.06 To assure the adequate cooling of the furnace tubes of the evaporator during start-up or in low load operation, a minimum flow rate of approximately 35 % TGMCR shall be maintained.

2.20.07 Bidder shall furnish complete details of start- up and low load operation system with separators and drain system and shall also provide detailed flow diagrams for the system offered.

2.21.00 Atmospheric Flash Tank

2.21.01 An alternate drain connection to enable start up of steam generator even when the Start up drain recirculation pump is not in service shall also be provided. The system shall comprise of an atmospheric flash tank and drain receiving vessel located in the Steam Generator area and shall be complete with all necessary valves, piping, level control system etc. The start up drain from the separator(s)/ Drain collection vessel to atmospheric flash tank shall be led through twin piping leg, each leg being provided with a motorised isolation valve and an Electro- hydraulic operated control valve. 2X100% pumps to transfer condensate from the receiving vessel to the main condenser shall also be provided. All necessary valves and discharge piping up to the flash tank in TG area will be in the Bidder's scope.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 2.21.02 The flash tank shall also receive other start-up drains from:
- Economiser system
 - Superheater system
 - Reheater system
 - Soot blower system
 - Mill steam system
- 2.21.03 The flash tank shall be adequately sized to take care of the total drain in the complete steam generator and power cycle piping system.
- 2.22.00 **Superheater (SH) and Reheater (RH)**
- 2.22.01 The superheater and reheater shall be of proven design, made of seamless tubes and shall be designed to maintain superheat and reheat steam temperatures at superheater and reheater outlet over the entire steam temperature control range (i.e. from 35% to 90% TGMCR rating for SH and 60% TGMCR to 100% BMCR rating for RH) under the following conditions. (The SH and RH shall continue maintain rated steam temperatures under extreme operating conditions like HP heaters out of service, BMCR condition and HP/LP bypass operation. The tubes shall be drainable to the maximum extent).
- 2.22.02 With permissible and normally expected unbalance or stratification in flue gas flow. (Temperature difference between left and right sides inside furnace not more than 15 deg C.)
- 2.22.03 With all specified mode of fuel burning.
- 2.22.04 Only the proven material for long periods of operations for the required pressure and temperature conditions shall be adopted. Suitable allowances in tube thickness shall be provided considering erosion due to fly ash, laden flue gas. Bidders shall furnish satisfactory explanations with the list of experience for the materials of construction of SH and RH tubes used. Maximum material grades to be used in one tube bank shall be limited to three (3). Suitable shrouding or wear protection shall be provided for the tubes coming in the area where the flue gas takes a severe bend viz., LTSH / LTRH headers / terminal tubes / bends/ top tube etc. to avoid erosion.
- 2.22.05 Clearances between the tube elements shall be convenient for cleaning and maintenance.
- 2.22.06 For horizontal tube bundles the arrangement shall be such as to permit free expansion without constraints.
- 2.22.07 The superheater and reheater elements shall be arranged to ensure the uniform steam distribution and minimum steam temperature variation across the width of the steam generator at all operating conditions and loads. Bidder shall indicate the expected temperature variation.
- 2.22.08 The system shall be designed with minimum possible use of de-superheating spray. The attemperators are to be of spray type fitted with an inner removable lining, so arranged that the lining could be removed readily without recourse to extensive cutting of the construction welds. Ample provision shall be allowed to enable internal inspection of the vessel by means of the intrascope. Complete superheater and



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

reheater temperature control system with necessary piping, block, control, isolation, drain, vent, check valves and instrumentation and controls shall be provided.

- 2.22.09 Maximum permissible spray attemperation flow (as percentage of main steam flow at super heater / Reheater outlet)
- i) Superheater attemperation 8% of main steam flow at superheater outlet.
 - ii) Reheater attemperation 3% of Reheat flow at reheater outlet. Above permissible limits shall be applicable to all boiler loads with any combination of Mills in service and shall be guaranteed by the Contractor.
 - iii) The SH/RH attemperation system shall, however, be sized for 12% of the rated main steam flow requirement for superheater and 8% of rated reheat flow for deheater, both at 100% BMCR load.
 - iv) The steam temperature downstream of desuperheater shall have at least 10 Degree Celc. superheat to ensure proper evaporation.
- 2.22.10 In case of RH temperature control is by means of damper control of the flue gases or gas recirculation, the bidder shall furnish list of such installations where the systems installed by the Bidder are in operation.
- 2.22.11 The superheater and reheater supports or hangers exposed to hot gases within the setting shall be of a heat-resistance material suitable for long life under the service condition.
- 2.22.12 Auxiliary steam tap-off connection for soot blowing shall be either from intermediate superheater header or from cold reheat line or from auxiliary steam header. In case the steam is tapped off from the cold reheat line or from auxiliary steam header, Bidder shall furnish a list of installation where such systems are in vogue and also the same shall be reflected appropriately in the turbine cycle heat balance diagrams. Suitable allowance shall be provided for the super heater and reheater tubes to counter the erosion condition.
- 2.22.13 Spray system for attemperation consisting of valves, pipelines and accessories shall be adequately sized for the maximum requirement. Suitable DC solenoid operated pneumatic block valves shall be provided to close in the event of unit trip out to prevent any water leakage. Arrangement of desuperheating shall ensure complete evaporation of spray water and avoid water carryover in the superheater. The station shall consist of one operating and one standby pneumatically operated control valves having individual motor operated valves at upstream and hand operated valve at downstream of spray control valves. Besides, dedicated non-return valves at downstream shall also be provided in order to prevent reverse flow. Location of spray water tapping from the feed water system shall be selected by the Bidder.
- 2.22.14 The offer shall bring out the scheme for reheater protection. The offer shall also indicate the maximum Steam Generator load for no flow through reheater.
- 2.22.15 All pendent SH/RH coils & spacer tubes shall have attrition pads (Minimum 3 mm thickness) at the physical contact point between two tube surfaces & near locking arrangement to avoid mechanical rubbing.
- 2.22.16 Necessary shielding (min. 3 mm thk) shall be provided between hanger tube & LTRH/LTSH tubes at their locking arrangement to avoid mechanical rubbing of tubes.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 2.22.17 All tubes bank shall have cassette baffles of minimum 5 mm SS plate to SS 304 (hardness minimum 180 HB (Front & Rear sides) with proper locking arrangement to avoid disturbance in flue gas path
- 2.22.18 For maintenance/inspection of SH/RH, provide:
- 1.5 m clear cavity height between two sections/banks of horizontal heat transfer surfaces for personnel access. For vertical surfaces, minimum clearance between the two banks shall be 600 mm.
 - Access openings along with air/gas tight hinged doors for approach to above maintenance spaces without any hindrance from hanger tubes.
 - All access doors shall be of 500x500 mm size (minimum).
 - Access doors 800 mm above the nominal floor level shall have access platform.
 - Hanger tubes of horizontal banks shall have access opening for crossing over.
- 2.22.19 Stainless Steel Erosion shields for all bends of outer most tube/coil/header of all SH/RH sections, screen tubes (1st two tube in FG flow direction) and hanger tubes in areas where flue gas temperature is below FEGT. For the pendant tube sections, the erosion shield on the leading tubes and wherever else considered necessary by the Contractor as per the proven product is acceptable.
- 2.22.20 The Steam Generator design shall ensure that no damage is caused to the Reheaters with sudden closure of turbine interceptor valve._
- 2.23.00 **Economiser**
- 2.23.01 The economiser shall be of non-steaming and bare tube type. The tube banks shall be of in line design. The design of the economiser shall be such that the tube elements can be easily replaced when necessary. Suitable allowance shall be provided for economizer tubes to counter the erosion. In order to achieve high boiler availability, all tubes in the economiser, HP superheaters and reheaters shall be easily replaceable.
- 2.23.02 It shall be ensured that the economiser design pressure exceeds the steam generator design pressure by an amount of at least equal to the pressure drop (friction and static) through the economiser at the 100% BMCR condition. Economiser design shall take into account the gas temperature and dust loading.
- 2.23.03 Economizer shall be
- Provided with ash hoppers along with high ash level switches/alarms, if economizer is placed in the second pass of Steam Generator.
 - Headers shall be located external to gas path and shall be completely drainable. If locating headers in gas path becomes unavoidable, than suitable erosion shields must be provided.
 - With minimum 63.5 mm clear side spacing (gas lane), with proper barriers installed, to avoid gas laning.
 - Minimum 1.5 m clear cavity height between two sections/banks of the economizer for maintenance access.
 - Access /Opening for each tube banks along with air/gas tight hinged doors.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- vi) Arrangement for off load water washing with necessary drainage connected to nearest drain shall be provided for economizer if two pass boilers are offered.
 - vii) The header shall be provided with drains and suitable opening with forged weld on caps for internal inspection and chemical cleaning. Inspection openings with forged weld on caps for headers.
- 2.23.04 Suitable allowance shall be provided for the economiser tubes to counter the erosion with minimum 1.6 mm erosion margin. Provide minimum 3.0 mm thick stainless steel erosion shields for leading/top 3 tubes of each tube bank of economizer. In addition minimum 5.0 mm thick sturdy cassette baffles shall be provided for all front side and rear side bends of the economizer banks. The cassette baffles shall cover complete bends and additional 300 mm straight tube length. Shield and baffle material shall be SS304 with hardness not less than 180 HB (Brinell Hardness).
- 2.23.05 The bidder shall provide adequately designed anti-vibration baffles in the second pass especially for economizer banks, and for LTRH if required.
- 2.23.06 Economizer coil shall be design evenly distributed in 3 bank pattern systems, like Upper bank, Intermediate bank and lower bank.
- 2.23.07 Adequate spacing shall be considered while designing economizer coil for erection, replacement, inspection and lifting during shutdown activities. Following points to be consider for the same,
- i) Adequate spacing shall be considered between LTRH/LTSH lower bank lowest coil and economizer top bank top coil.
 - ii) Adequate spacing between economizer top bank lowest coil and intermediate bank top coil. Intermediate bank lowest coil and lower bank top coil.
- 2.23.08 Length of economizer coil shall be designed such that 225 to 250mm gap shall be maintained between coil end and water wall tube on front & rear side.
- 2.23.09 Erection, replacement, lifting and inspection of economizer coil/module/assembly are done by cutting coil end and hanger end. There shall be provision of two cutting elevation and these elevation shall be same as that of elevation to be used for erection elevation.
- 2.23.10 Tube and header materials
- i) The materials shall be appropriate for most adverse operating conditions and as specified elsewhere in this specification (Alloys containing molybdenum only without any suitable stabilisation with vanadium and chromium shall not be used. Total content of molybdenum, tungsten, silicon, vanadium, titanium, tantalum etc. individually or all together, if not otherwise specified, shall not exceed the limits specified in relevant material codes).
- 2.23.11 On gas inlet side of the Economizer, provision of space shall be kept for future addition of minimum 20% economizer surfaces. Structure/hangers design to be suitable for loads due to this additional water filled tubes also.
- 2.24.00 **Headers**
- 2.24.01 All headers in high temperature gas path shall be located outside the gas path.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 2.24.02 The hand hole openings in headers shall be so located as to provide suitable access to maintenance. All hand hole plates shall be designed for seal welding. A minimum number of header hand holes required to facilitate cleaning and inspection of the headers shall be provided.
- 2.24.03 The header vents, drains, pressure gauges, steam and safety valve connections shall be of weld-end type. Instrument tappings as required including test connections shall be provided.
- 2.24.04 All tubes or attachments to headers shall be full strength welded. No rolled or rolled and seal welded joints shall be used.
- 2.24.05 All headers shall be thoroughly cleaned and be free of scale by shot blasting on the inside. All connections of pipes to headers shall be made by means of welding transition piece between headers and piping. Pipe and header end covers shall not be of flat type design without prior approval from the Owner/Consultant.
- 2.24.06 All valves that require operation during start-up or shutdown of the steam generator shall be electric motor operated, except if specifically stated otherwise. All motor actuators shall be designed to meet the torque requirement due to maximum differential pressure. In addition to these motorised valves, any other service which calls for motor operation shall be motorised and those motorised valves shall be listed in the bid. All motor actuators shall be of same make only.
- 2.24.07 Drains from all headers, gauge glasses and integral piping of steam generator shall be terminated into one or more drain collection headers and finally shall be fed to atmospheric flash tank.
- 2.24.08 Field welds in large diameter thick walled headers or pipes shall be avoided to the extent possible
- 2.24.09 Preservation of Boiler either by N₂, dry air or treated water shall be considered by the Bidder.
- 2.25.00 **Air and Flue Gas System**
- 2.25.01 The air and flue gas system shall be designed to meet the requirements from start-up to 100% BMCR conditions as indicated in Data Sheet-A and for range of the fuel characteristics specified in the Project Information. The entire flue gas system including the Boiler flue gas passes shall cope with the explosions and /or implosions, which might occur even at typical or extreme conditions.
- 2.25.02 The air and flue gas system shall be a balanced draft system and shall consist of PA Fans, FD Fans & ID fans as mentioned herein.

Name	Type	Configuration for Boiler	
PA fans	Axial with blade pitch control	2x60% BMCR	Both are provided with SCAPH at common discharge bypass.
FD/SA Fans		2x60% BMCR	
ID Fans		2x60% BMCR	



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

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BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

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TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 2.25.03 2 x 60% capacity trisector rotary regenerative air preheater (RAPH), with associated drive motors, cold air, hot air, tempering and flue gas ducting and dampers to handle the steam generator requirements. The air preheater shall be provided with air motors with air receiver for coasting down operation. The air receiver capacity shall be such that during black out condition the air receiver shall be able to supply adequate air for safe shutdown of RAPH. 2 x 50% Steam coil air preheaters (SCAPH) shall be provided in the bypass air duct (FD fan) so that same can be used when required. Condensate from SCAPH can be led to atmospheric tank (provided for start-up purposes of boiler and collects drainage of evaporator)
- 2.25.04 The air preheaters shall be of regenerative type with vertical main shaft, counter flow, enclosed in a gas tight insulated casing. The design shall ensure that the air preheaters shall be capable of operating for extended periods of time without pluggage of flow areas between heating element plates. Suitable lube oil system, thrust bearing, pumps, valves, coolers etc shall be provided.
- 2.25.05 Bearings (forced lubricated and oil cooled):
- Cold end: Spherical roller thrust (Kingsbury thrust bearings are not acceptable)
 - Hot end: Radial guide bearing. _
 - Only metallic hoses shall be used for bearing cooling/lubrication. Rubber hoses are not acceptable. The bearings shall have a minimum L10 life of 100,000 hrs.
- 2.25.06 Air heaters elements arranged in baskets and easily removable in groups/baskets for maintenance. Air heater seals shall have followings:
- Externally adjustable and easily replaceable seals.
 - The maximum air-in-leakage to flue gas of the Steam Generator with coal shall be guaranteed and demonstrated along with the Boiler PG test. The Contractor shall also demonstrate that the drift in air heater leakage (percentage change in air-in-leakage) does not exceed 1%, one year after demonstration of above guaranteed air-in-leakage. Within this period of operation till all air heater leakage demonstrations are completed there will be no need for any shut down for seal replacements or any internal adjustments. The seal design/construction shall be such that the above requirements are satisfied.
 - Seals shall have life not less than 2 years (with leakages not exceeding guaranteed limits)
 - The seal should be of flexible soft thin material and hardness should be less than that of sector plate / seal plate.
 - Alternatively, the bidder can also select the seal material based on its standard practice and proven design only for similar applications so as to ensure that these offered seals meet the above guaranteed life. The bidder will provide the basis for the selected material & seals type along with proven references.
- 2.25.07 Auto seal arrangement shall be envisaged for both axial and radial. Followings are to be Provide:
- Sufficient space provision for future installation of minimum additional 15% of APH heating surface area shall be made in the design so that, the same can be installed, if



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

required. The bearings, supports, casings, drives for APHs etc. as well as APHs supporting structures and foundation loads are designed to take care of all the requirements due to the above addition of heating surface. APH design shall enable easy modular installation of heating surfaces including 15% additional surface.

- ii) Soot Blowers in the Flue gas hot end and cold end. A pressure transmitter shall be provided at the downstream of each Soot blower valve for APH.
- iii) Basket removing facility along with/without removal gear, if applicable as per vendor's standard design.
- iv) Hinged / bolted access doors in air heater housing for internal inspection / cleaning / maintenance and for replacements of elements without dismantling air heaters or alternate arrangement for replacements of elements without dismantling air heaters as applicable based on standard design.
- v) Observation ports with vapour proof light at air inlet duct for rotor inspection.
- vi) Facility for positioning of rotor while element replacement (manual or otherwise),
- vii) Galleries and platform around air heater and access to observation ports/access doors etc. Platforms to be capable of taking load and storing elements for at least one sector.
- viii) Special T&P kit for removal of bearings and for replacement of shaft.
- ix) Leakage control system - sector plate (s) system with drive unit & accessories shall be provided at hot end to reduce the hot end leakage and energy loss. This shall also online maintain the seal gap/radial seal clearance based on pre-set temperature and thereby ensure leakage control at various loads. The bidder at its discretion can also optimize the above clearances, over & above the methodology as given above, by also measuring the actual gap between seals and sealing surface. However, in such case suitable calibration and checks to be ensured during commissioning for synchronism in above two approaches. In any case, all the guarantees as specified are to be ensured by the bidder.

2.25.08 Provide thermocouple type fire sensing device and redundant temperature element for each bearing and oil sumps. Fire fighting facilities on cold end and hot end of the air preheaters shall be provided and the fire fighting facilities shall cover both flue gas side as well as air side of air preheaters. Deluge system water quantities for hot end fire fighting facilities shall comply with NFPA 850 requirements. Necessary water draining system, connected to station drains shall also be provided. The structure shall be strong and light in weight and shall be sufficiently flexible to operate without difficulties under conditions of large temperature gradients through the rotor in the axial direction.

2.25.09 The heat transfer plates used in different layers shall be of different material combination depending upon suitability to withstand extremes of temperature condition. Use of corrosion resistant materials shall be considered to avoid corrosion at the back end.

2.25.10 Provide Handling facility (covering structural steel/runway beams, trolley/hoists, along with platform along runway beams) for conveying, lowering and placement of elements/baskets to ground level. The air heater design shall be such that on-load cleaning by suitable steam soot blower is feasible. The location of the blower shall be on the flue gas side. For offload cleaning, water washing spray nozzles on an extended



fixed arm on both hot and cold ends shall be provided along with required supply piping, valves etc.(supply to be tapped from Owner's service water system). The locations can be either on air or flue gas side. Provision for fire fighting system in the Air pre-heater shall be provided both on air and gas side and on cold and hot ends, along with required piping, valves etc, fire sensing devices(to be connected to fire fighting system. Facility of Hoppers at the bottom shall be provided for collection and disposal of ash with necessary RF level switches, approach plat forms etc. High ash level indicator switches & alarm shall be provided for all APH and Duct

2.25.11 The general design requirements for the fans shall be as follows:

- i) The fan shafts are to be carried in bearings on either side independent of the casings. The overhung impellers shall be avoided as far as possible. The rotor shall be over speed tested to at least 25% above the maximum operating speed and shall be dynamically balanced.
- ii) The first critical speed of the rotor shall be well above the operating speeds (by at least 15%).
- iii) All constants speed fans shall be designed for under and over frequency operation in range of 47.5 Hz to 52.5 Hz without any reduction in its performance. The fan/motor bearings shall be of heavy duty self aligning type and shall be designed to take the loads due to dead weight, unbalance and thrust of the motor assembly.
- iv) Forced oil lubrication system (if offered) for the fans and motors shall consist of 2 x 100% oil pumps each with motor, 2 x 100% oil coolers and filters; one (1) oil tank.
- v) The flow induced pulsation should be avoided by suitable design of fan and connecting duct work.
- vi) Suitable design of shaft sealing shall be provided to prevent ingress of atmospheric air.
- vii) Each bearing shall be provided with an oil bath to prevent bearing damage in case of complete loss of plant auxiliary power when the fans must coast down without power. Forced outages resulting from a failure of the oil circulating system shall be minimised by sizing the oil reservoir in bearing housing to be capable of maintaining lubrication for extended periods without the system in service. The fan bearings shall be provided with temperature elements and thermometers for bearing temperature measurement as stipulated elsewhere in the specification. Each fan bearing shall be provided with oil level indicator and a screwed drain plug. Adequate sealing arrangement shall be provided at each end of the bearing housing to prevent leakage of lubricating oil. For mounting of vibration pads/pickups, flat surfaces shall be provided both in X and Y directions, by the Contractor on the bearing housing. In case of oil lubricated bearing the design shall be such that bearing are lubricated by external oil lubricating system in which oil is cooled by external cooler. Bearing shall contain sufficient oil to take care of fan coasting down period. Three nos. Duplex Pt-RTD (100 ohm at 0 deg.) with dual input temperature transmitters shall be provided for local and remote monitoring of each bearing metal temperature of fans.
- viii) Flexible coupling shall be used between the prime mover and the fans.
- ix) Silencer shall be provided at the inlet of FD and PA fans with weather hood and inlet screen and acoustic baffles. Suitable approach for maintenance of Fan silencers shall be provided.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- x) The fans shall be capable of maintaining balanced draft conditions in the furnace with any one or both PA fans, any one or both FD fans, anyone or both ID fans in operation while burning fuel as specified in the general technical specification. The characteristics of all fans included in this system shall be suitable for parallel operation over the entire load range. Suitable materials for the most conceivable stringent working conditions shall be used for manufacturing viz., High strength aluminium alloy for fan blades, sheet steel for casing, cast iron or welded steel for base plate etc for PA and FD/ID fans. Natural frequency of fans components should be sufficiently away from fans operating speeds. The fans shall be statically and dynamically balanced and shall be checked and further adjusted at site (if necessary). The fans component design shall be such that the components can withstand torsional stresses three times the normal full load motor torque at all speeds. The shaft material shall be 15MO3 or better.
- xi) Air flow measuring devices shall be provided at suitable points Viz., inlet to Mills (PA fan), secondary air ducts etc. Necessary platform with approach arrangement shall be provided for flow measuring devices.
- xii) Layout of all fans shall ensure inter-changeability of impellers. Similar fans shall have same direction of rotation.
- xiii) Air/Flue gas flow shall be blade pitch control. The system shall be capable of working on automatic mode for all regime of operation in a steady and stable manner. The final control element shall not have any backlash, plays etc., and shall operate in the range of 20% to 80% depending upon generating loads up to Boiler MCR.
- xiv) **Fan Casing:**
- The fan casing shall be split to provide easy removal of the fan hub/impeller for replacement and repairs.
 - The sections shall have gasket joints to ensure airtight sealing.
 - Access doors shall be provided in each suction chambers, casing and diffuser.
 - Fan casing shall be properly stiffened to minimum vibration and distortions during operation.
- xv) **Special construction Feature**
- Fan components shall be designed for torsional stresses of three times the normal full load motor torque at all speed.
 - The fans shall be suitable for parallel operation and sharing the load capacity over the entire range without hunting.
 - The fan suction shall be provided with rigid bird and trash screen assembly and shall have suitable arrangement to prevent rainwater from directly entering the fan.
 - Drain connections shall be provided at bottom most point of the fan housing to the nearest trench.
- xvi) **Fan Vibration Monitoring:**
- All accessories/ arrangements like flat surfaces, vibration pads/ pick ups etc shall be provided for fan vibration monitoring as per OEM recommendations.



- b) The complete installation of all fans shall be under the supervision of the fan manufacturer respectively.
- c) Stall detection probes shall be installed on the all fans. The probes shall be integrate with the stall duration measurement and integrator to enable assessing to total stall duration of the fans during the life time of operation.
- d) Fan components along with servo/blade pitch control mechanism shall be designed to withstand and continuously operate with the maximum air or flue gas temperature that these fans will be required to handle. ID fan component shall also be designed to withstand the excursions in flue gas temperature up to 300 degree Celsius, which may persist for about 30 minute duration. Such temperature excursion will not inhibit the safe and smooth operation of fans or cause any damage or increased maintenance._

2.25.12 The air and flue gas system design shall be as below:

- i) The MCR of the fans shall be so determined that with all electrostatic precipitator (ESP) sections in operation and the electrical system frequency at 50 Hz. the steam generator shall meet 100% BMCR condition with sufficient controllability over furnace draft. However the best efficiency point of fans shall be closure to 100%TGMCR condition.
- ii) Air and flue gas system and components shall be designed with consideration of SCR and Wet FGD installation in the inline path of the unit. The pressure drop across the wet FGD shall be made accountable for considering the duct design, ID fan sizing.
- iii) The fans characteristics shall be compatible with pulverised coal system resistance and Boiler operation at various loads.
- iv) The BIDDER shall furnish the PA, FD and ID fans operating curves (head vs. flow) indicating efficiency lines, steam generator resistance line for normally fouled conditions both at 50 Hz, and 47.5 Hz., showing the MCR and test block points.
- v) An adequate number of interconnecting, isolating and control dampers with suitable drives shall be provided on all cold air, hot air, seal air and flue gas ducting before and after the equipment on this system ducting to permit proper operations. The frames of the dampers shall be rigid. The control dampers shall be pneumatically operated and isolation dampers shall be electrically operated. Alternatively Bidder can supply electrically operated control dampers if it is cost effective.
- vi) Maximum air velocity shall be 16 m/s.
- vii) Maximum gas velocity shall be 13 m/s, except flue gas duct from ESP outlet to Chimney inlet.
- viii) Maximum flue gas velocity from ESP outlet to chimney inlet shall be 15 m/s.
- ix) The gas velocities shall be selected considering ash content of the fuel.
- x) Flue gas velocities, shall be maintained within the specified limits, especially between boiler outlet to ESP such that the ash accumulations at part/low loads (corresponding to requirements specified anywhere else in the specifications) are minimized.
- xi) The flue gas flow & ash accumulation pat-terns at such part/low loads shall be studied based on the CFD/Physical model test (PMT) of ducts & ESP as part of this



specification scope. The same along with bidder's experience of similar cases (boiler/coal & ash type etc.) shall be considered for selecting the final gas velocities. Bidder shall have to carry out CFD & CAVT at the time of commissioning and after 15000 running hours of SG for studying flue gas profile for better gas distribution and accordingly necessary modification has to be carry out without any extra cost for any disturbance observed.

- xii) The velocities in ducts shall not exceed the above limits, under the following conditions, all occurring together:
 - a) Design/best/worst coal firing at 100% BMCR load whichever gives maximum flow
 - b) 20% excess air over and above the stoichiometric air at economiser outlet.
- xiii) The size of interconnecting duct shall not be less than the individual ducts to be connected.
- xiv) The design of all flue gas ducts, air ducts and the wind box shall be compatible with furnace design pressure.
- xv) The gas and air ducts shall be designed for wind loads as specified for the steam generating unit proper and their own weight including fly ash load which may get deposited at the duct bottom, insulation and lining. The top of the ducts shall be crowned to ensure proper drainage. However velocity shall not be more than 14 m/sec to 16m/sec.
- xvi) The duct work shall be free to expand, but it shall be rigid against wind and seismic disturbances. Adequate provision shall be made for all expected expansion or contraction. Acoustic insulation shall be used on air and gas ducts, if required to restrict the noise level as per the MOEF requirements.
- xvii) All gas and air ducts shall be designed to ensure uniform distribution of gas and air flow to the various portions of the unit. The design shall be such that turbulence and resistance are minimised particularly in the proximity of fans and air-heaters.
- xviii) All gas and air ducts consist of turning vanes / baffle plates, stiffening devices, expansion joints, interior bracings, access doors and brackets, support structures and hangers as necessary. Duct work should take in to consideration for installation of wet FGD in line with flue gas path of the unit. The design of ducting should consider wind loads, dead weights of material, lining, insulation etc., ash accumulation in case of horizontal ducts, expansion joint reaction. The suggested material of construction is ASTMA36 for duct plates, vanes, structural shapes, ASTM A53 for pipe struts, trusses, ASTM A307 for erection bolts etc.
- xix) Aerofoils shall be provided in the air ducts for the measurement of total air flow.
- xx) Locking devices shall be provided to permit locking of the dampers in both open and shut positions.
- xxi) The inlet dampers for ID fans shall be located in horizontal duct of main inlet duct to avoid fly ash build up on closed dampers.
- xxii) The air preheater, economiser and duct hoppers shall have provision for removal of fly ash during maintenance period when the steam generator is out of operation. To



facilitate such fly ash removal, BIDDER shall provide a 100% gas tight isolation gate near the hopper bottom.

- xxiii) Electrically operated single plate guillotine type isolation dampers along with drives shall be provided as specified in Data Sheet-A. The inlet dampers for ID fans shall be located in horizontal duct of main inlet duct to avoid fly ash build up when in closed position.
- xxiv) Bidder shall to provide canopy of duct width (above duct insulation) on top of the ducts installed below Coal Belt Conveyor system.
- 2.25.13 All necessary regulating and isolating dampers shall be provided for the efficient and convenient operation of the steam generator. The BIDDER shall furnish a list of all dampers, their purpose and torque rating etc. together with the details of actuators and accessories for remote control. Powered dampers shall also have provisions for manual operation during emergency / maintenance along with graduated local position indicator.
- 2.25.14 The single plate dampers shall be of heavy duty construction. All dampers/louvers shafts shall be rigidly constructed to prevent bending, vibrations and distortion. They shall be balanced about the bearing shaft axis. They shall be designed to withstand the operating air/flue gas temperature without distortion. The spindles shall be adequately sized and bearings suitably insulated to protect over-heating. The construction shall be such that the shaft bearings are mounted outside the damper box channel and arranged for convenient inspection. Stuffing boxes shall be provided on all damper blade shafts.
- 2.25.15 The dampers shall be capable of effectively stopping the flow in the closed position and while in full open position shall cause minimum pressure drop. Special attention shall be given to the design of sealing arrangement of isolating dampers to ensure that they provide a positive shut off when closed. Open and Close positions shall be clearly marked on each damper.
- 2.25.16 As a minimum power operated gas tight dampers shall be provided i.e., guillotine type dampers at hot air duct inlet to mills, inlet & outlet of ESP stream, Before and after ID fans, inlet of APHs on flue gas side , discharge of PA fans, discharge of FD fans, and at inlet & outlets of APHs on air side. Guillotine type dampers shall provide in horizontal ducts only to avoid ash build up in ducting.
- 2.25.17 Pressurisation fans to achieve 100% sealing shall be adopted for dampers at ID fans discharge, APHs air side outlet dampers and mill inlet dampers.
- 2.25.18 The dampers in flue-gas paths shall be so located that the build-up of grit behind the damper blades is reduced to a minimum. Manual operation facility shall be provided for all dampers.
- 2.25.19 All damper actuators and the complete link mechanism connecting the dampers and their actuators shall be furnished. The linkage mechanism shall be so designed that the actuators can be mounted on a gallery or floor level and shall be subject to the Purchaser approval.
- 2.25.20 Outlet dampers of seal air fans, scanner air fans and emergency dampers of scanner air shall be pneumatically operated suitable for remote manual operation. All



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

pneumatic operated inter-locked dampers actuators shall be provided with D.C. solenoid valves.

2.25.21 All dampers shall be arranged to facilitate local manual operation from a gallery or floor level. The operating gear shall be fitted with a graduated indicator and shall be designed such that the damper may be retained in any position. The isolating dampers shall, in addition be fitted with locking devices to permit locking in the fully open and shut positions.

2.25.22 Manual damper operation shall be accomplished by chain operated accessible from platforms attached to the ductwork support steel.

2.25.23 The flue gas duct layout shall be designed considering the following aspects:

- i) The change of direction of flue gas duct shall be gradual to avoid ash collection at the bottom of the duct and also to prevent erosion by local concentration of fly ash.
- ii) While designing the duct system proper care shall be taken for the consideration for installation SCR system and wet FGD.
- iii) The number of direction changes of the flue gas duct shall be minimal to minimise the ash collection points.

2.26.00 Start-Up / Warm-Up and Support Oil System

2.26.01 Design and installation of LDO firing system shall comply with N.F.P.A. (National Fire Protection Association 31) standards and/or recommendations or other similar standards. Changeover from one fuel to another should be possible without reducing the load on the Unit.

2.26.02 The start-up/warm-up and flame stabilisation oil system shall be as described under:

- i) The Light Diesel Oil (LDO) will be used to bring the steam generator up to the required operating temperature during start-up. The LDO shall also be used for stabilisation operation at low loads. Bidder shall provide a proven start-up system for cold/warm/hot conditions. The complete LDO system shall be designed to cater to maximum of 30% BMCR requirement. Bidder shall clearly indicate the steam generator load below which LDO stabilisation for coal burning is required. However, the turn down ratio with coal firing shall be around 3:1 .
- ii) The LDO system shall consist of -
 - a) One (01) No. LDO tank of 500 KL capacity
 - b) Oil transfer system from existing and new LDO storage tank tapping from outlet nozzles of existing LDO storage tanks shall be provided by bidder
 - c) 2x100% LDO transfer pumps including matching suction strainers
 - d) One (1) no. Storage cum day oil tank, Filtration and pressurizing unit having 2x100% (1Working +1 standby) capacity pumps with matching suction strainers
 - e) And consisting of 2x100% capacity matching pressure filters, burners, high energy arc igniters, scanners, and scanner cooling air system.
 - f) Filling Arrangement to new LDO tank from existing LDO unloading system

	GUJARAT STATE ELECTRICITY COPORATION LIMITED	VOLUME - III
	1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE AREA AT UKAI TPS	PART - A
	BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01	SECTION - 1
	TECHNICAL SPECIFICATION STEAM GENERATOR & AUX. INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx & MRHS	REV. - 0

- iii) LDO safety and burner shut off valves, pressure control valve, pressure regulators, solenoid valves, safety valves, hangers,
- iv) LDO metering units, piping and valve necessary for bypass and isolation, all the piping from existing plant LDO tank to Day oil tank and complete system from Day Oil Tank to boiler front and return with all necessary valves and specialities shall be in the scope of bidder.
- v) LDO burner header recirculation control valve, recirculation piping with valves etc.
- vi) Necessary instrumentation for oil flow measurement including all its accessories shall be provided.
- vii) All necessary equipment and controls in accordance with NFPA 85C as applicable.
- viii) Minimum life of burner tips, before needing any maintenance replacement shall be min. 16000 hrs.

2.27.00 Ignition System

- 2.27.01 High Energy Arc (HEA) igniters shall be provided to ignite LDO. One HEA igniter for each fuel oil gun shall be provided. The igniters system offered shall be of well proven design of reputed make.
- 2.27.02 Ignition system shall be complete with all electrical gadgets viz., transformer control cabinets, igniters, cabling, etc. to make the system complete by itself and shall be integrated with BMS.
- 2.27.03 2 x 100% Scanner Air Fans for all the scanners of one Steam generator unit shall be provided preferably at firing floor and away from Economizer Hopper ash evacuation system to avoid any ash ingress in scanner air fan system. The oil burner shall be of well proven make in service and the design shall provide accurate fuel and air ratio control, thorough mixing of fuel and air at all loads and shall avoid flame impingement on the steam generator tubes/ducts.
- 2.27.04 Minimum turn down ratio as specified shall be provided. The burners shall be remotely operated and the entire operation of purging steam and fuel oil sequencing, steam blow-off shall be automatic after the initial command. Adequate number of position indicating contacts for integration into burner management system (BMS) shall be provided.
- 2.27.05 The air fuel ratios around the burners shall ensure low NOX emission. The BIDDER shall furnish details of the system proposed to be adopted by him for NOX emission control.
- 2.27.06 The flexible hoses (armoured type) shall be provided for oil and steam connections.
- 2.27.07 The burner shall be arranged for automatic advancement and retraction under interlock conditions. The servo drives shall be pneumatically operated, the station compressed air being available for this purpose.
- 2.27.08 The oil burners shall be provided with their discriminating flame sensing devices so that the admission of oil may be automatically shut off and oil gun withdrawn in case of flame failure. The flame sensing devices shall be self contained and shall be unaffected by dirt, oil film and ambient conditions. The oil firing scheme shall incorporate automatic purge interlock to facilitate restarting after such conditions.



Automatic ignition system to initiate the flame in the furnace shall be included. However facility for the manual operations shall also be provided. Ignition system shall be complete with ignitors suitable for ignition of heavy oil directly. Necessary piping, valves, control and instrumentation and all other equipment necessary for the completeness of this system shall be provided.

2.27.09 The oil firing system shall include all connections and provision for instruments and devices required for supervision and interlocking with all associate auxiliaries during purging, start up operation and shut down.

2.28.00 Coal Preparation and Firing System

2.28.01 The coal storage, preparation and firing system shall commence from the raw coal bunker and its shut-off valve/ gate at raw coal bunker outlet and shall include raw coal feeders with shut off gate at inlet, coal pulverisers, primary air and seal air fans, pulverised coal piping, coal burners and associated auxiliaries.

2.28.02 The design of coal preparation and firing system shall ensure the following:

- i) Complete safety of the plant, equipment and the personnel.
- ii) Complete compliance with the latest NFPA (USA) requirements and other requirements specified hereinafter.
- iii) Coal supply to the mills shall be from the individual coal bunkers having useful storage capacity of minimum 16 hours with the unit operation at 100% BMCR while design coal as specified in general specification.
- iv) Coal bunkers shall complete with lining, inertisation, dust collecting equipments and deblocking devices (e.g. Vibrators)
- v) Comprehensive flow ability study shall be conducted for the coal bunker hopper to ensure smooth flow of coal in all seasons with different moisture contents and different percentage of mill operating configurations. Bunker hopper valley angle shall be considered as 73 deg for bunker sizing in the technical offer or as per coal flow ability study conducted as per specification requirement whichever is maximum.

2.28.03 COAL SHUT OFF GATES/VALVES, CHUTES

- i) Bunker shut off gate(s) and coal feeder inlet gate(s) shall be provided with the following features:
 - a) Size of gates/valves shall be suitable for round bunker opening of minimum 914.4 mm (36").
 - b) Shut off gates/valves shall be motor operated, with double rack and pinion drive arrangement and shall be of non-jamming type.
 - c) Gate/ valve design shall ensure dust tight enclosure and shall be of self cleaning type.
- ii) Shut off valves/gates shall be designed to operate with "bunker full of coal" condition without its motor getting overloaded. Normal motorised as well inching operation of these shut off gates/valves should be possible from the feeder floor. For manual operation from feeder floor level, wheel and chain shall be provided for each gate/valve.



- iii) The chutes between bunker outlet gate and inlet to the coal feeder shall not have internal diameter less than 914.4 mm. The chute between feeder outlet and pulveriser inlet shall not be of internal diameter less than 600 mm.
- iv) The chutes shall be made of minimum 12mm thick SS-410 material and shall be of fully welded construction. The chute between feeder outlet and pulveriser inlet shall have a SS lined hopper with suitable reinforcement. The provision shall be made for the insertion of poke rods in two directions opposite to each other at outlet of the bunker and inlet of the feeders.
- v) The arrangement of permanent bunker emptying chute along with necessary coal flow diversion valve shall be provided between each bunker and RC feeder. Necessary access shall be provided for operation of coal flow diversion valves. The emptying chute shall enable unloading of bunkers on trucks at ground level. An arrangement with a temporary chute fitted on the bunker downspout along with a permanent chute from the feeder floor to the ground level shall also be acceptable
- vi) Suitable indicators shall be provided in the downspout between bunker and feeder to detect presence of coal flow to ensure minimum seal height at inlet to feeder and trip the feeder if the level of coal tends to be below the seal height.
- vii) All components coming in contact with coal and the roller bearing shall be of stainless steel material.

2.28.04 COAL FEEDERS

- i) The raw coal feeders shall be of Rotary gravimetric, drum type. Each RC feeder shall be sized for 1.2 times the maximum capacity of coal pulveriser. The feeder casing shall be designed to withstand an explosion pressure of 3.5 kg/cm²(g).
- ii) The RC feeders shall comply with all the stipulations of NFPA.
- iii) All components coming in contact with coal shall be made of stainless steel.
- iv) All site equipment shall be suitable for 70°C ambient temperature and other environment conditions envisaged.
- v) Each feeder shall be equipped with:
 - a) Variable speed motor or transmission
 - b) Worm reducer assembly
 - c) 1 inspection door 0.5 x 0.5 above coal feeder and at front and rear side
 - d) Temperature indicator
 - e) Inner illumination lamps
 - f) Inspection windows
 - g) Control gate with outside scale
 - h) Chutes between feeders and mills.
- vi) Detection for "No coal" flow shall be provided to stop the feeder when no coal is detected on the rotor and when pluggage occur at feeder outlet. Paddle type coal alarm switch shall be provided for this purpose over the feeder conveyor for indication



of loss of coal flow and near the feeder discharge to stop the feeder in the event of coal pluggage at the feeder outlet.

- vii) The feeder control system shall be microprocessor based. Coal weighing shall be automatic and shall include local and remote indication for rate of flow and totaliser counter. The feeder control cabinet shall be located in control equipment room (CER).
- viii) The mass flow of the coal powder shall be adjustable with online orifice adjustment using micro wave based flow measurement.
- ix) The weighing accuracy of the feeder shall be + 0.5% with repeatability of 0.1%. Facility for in-built calibration shall be provided.
- x) The following facilities shall be provided for the feeders:
 - a) Spraying water inside the casing.
 - b) Providing purge air to the feeder.
- xi) Feeders shall be provided with adequate number of manholes on for quick and easy release of the feeder jamming. Easy access to any part of the feeder internals shall be possible without dismantling the complete casing.
- xii) Slip-on coupling for chute connections (at inlets of the R.C. feeder and the coal pulverisers) with SS 410 inner ring shall be provided.

2.28.05 COAL MILLS

- i) The BIDDER shall note that the minimum stable load without fuel oil support for pulverised fuel burning system shall not be more than 30% of steam generator MCR load with Design coal.
- ii) The BIDDER shall note that the Coal Mill combination shall be (N+1), here, N=7 working and 1 standby (1 under maintenance); i.e. total 8 no. of mills and sizing shall be done on the basis worst coal, BMCR capacity and 90% maximum loading. However, Bidder is free to suggest alternative mill layout and configuration keeping N+1 concept in to consideration.
- iii) *Coal Mills Design*
 - a) The coal pulveriser shall be of vertical spindle type. Each mill shall be fed with coal by an independent coal feeder.
 - b) The milling system selected shall respond to load change, remain in service for long operating periods, maintain prescribed performance throughout the life of elements and accept wide variety of coal.
 - c) The classifier design shall be capable of maintaining rated conditions of fineness under all conditions of operation, load changes and specified fuels. Further, the classifier vanes shall be adjustable externally and shall be lined with suitable wear resistant material to ensure the guaranteed wear life.
 - d) The classifier shall ensure reduction in particle of 50 mesh and increased quantity through 200 mesh percentages to ensure uniform sizing and distribution of particles. Fineness adjustment shall be possible while the mills are in service. Coal fineness should be 75% through 200 mesh.
 - e) Outlet of the classifier shall have aerodynamic shape to prevent eddies.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- f) Provision shall be provided in the mill design for future accommodation of rotary classifier.
- g) Mill grinding ring/race shall be segmental and grinding elements must be wear resistant and shall be made of superior Hi-chrome or equivalent material to ensure the guaranteed wear life as indicated in datasheet A.
- h) Seal air fans for all the mills shall be provided for steam generator unit. The fans shall preferably be located at ground floor.
- i) The sealing system shall prevent ingress of any dust into the bearings and leakage of coal-air mixture to atmosphere.
- j) The seal air fans shall take their suction from atmosphere/PA fan cold air duct. Silencers shall be provided, if required, at the suction of the fans to restrict noise level within permissible limits.
- k) Each mill shall be provided with its own forced lubrication oil system, including 2x100 % oil coolers, oil tank, 2 x 100 duplex filters and 2 x 100% oil pumps. The design of lubrication system shall ensure continuous operation of mill bearings Sealing air connections and seals shall be provided on the mill journals and on the mill casing in order to protect the bearings against the entry of dust. The gear box shall give trouble free operation of not less than 100,000 hours of mill operation.
- l) The mill motors shall be adequately sized and selected motor capacity shall enable restart of the mill after a trip with mill full of coal. Such restart shall not call for any emptying of the mill.
- m) The material of construction of wear parts shall be selected taking into account highly abrasive nature of coal resulting from coal contamination with silica sand and alpha quartz.
- n) The grinding rings/ race shall be made of material having hardness of minimum 550 BHN at the surface with adequate chilled depth. The grinding rolls shall be of insert type sinter cast rolls with minimum hardness 350 BHN. Minimum difference between hardness of rings/race and rolls shall be 100 BHN. Tapping points shall be provided on each pulverized coal pipe at mill outlet and shall be suitable for coal sampling as per ISO 9931.
- o) The sampling provisions shall be complete with screwed plugs, compressed air purging connections at tapping points, heating arrangement and other requirements as per ISO 9931.
- p) One (1) no. of Rota probe shall be provided for steam generator for coal sampling as per ISO 9931. Further, four (4) nos. of Dirty Pitot tubes shall be provided for steam generator and shall be suitable for measurement of coal-air velocity in the coal pipes.
- q) Convenient approach/access from nearest platform floor shall be provided for coal sampling/ measurement points.
- r) The mill shall be capable of running at part loads and ensure minimum turn-down ratio of 2.5:1.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- s) It shall be possible to isolate the mills from the hot air/gas ducts and from the dust ducts in such a way that the Steam Generator operation will not be disturbed when isolating one mill, and that the maintenance work such as rearmouring has not to be done under hard conditions. Doors of the mills shall be provided with hinges and quick acting opening & closing facilities.
- t) All mill wear parts shall be arranged so as to facilitate easy replacements without total dismantling of mill. Suitable measures shall be taken to prevent, under all operating conditions, each part of the mill by being endangered by over temperature. Lifting and hoisting devices required for maintenance shall be provided.
- u) Adequate numbers of access doors/windows with access ladders shall be provided to facilitate access to various parts of mill. The access doors shall be suitable for on load inspection and maintenance of the mill. The oil pumps and filters shall be readily accessible.
- v) Necessary ladders and approach platforms for mill bay hoist shall be provided at one end/ corner to carry out any maintenance activity on hoists.
- w) Insulation shall be provided around the dust guard area.

2.28.06 INERTING SYSTEM FOR MILLS AND COAL PIPES AND DUCTS

- i) Special care is to be taken to avoid explosions inside the mills and coal pipes, especially when burning coal with a self-ignition temperature of 220°C and high volatile content.
- ii) The provision of the plant with an inerting system will be mandatory. It shall consider an inerting system based on steam with motor operated valves and all relevant equipments.
- iii) Inerting system shall be capable of performing the following function:
- iv) The system shall deliver a high inerting flow to the mill to quickly reduce the oxygen level in the mill to 7% to reduce the explosion potential. The system shall be designed to meet the above flow requirements in the event all pulverisers require simultaneous inerting.
- v) The system shall deliver a low inerting flow to the off-line mill to maintain inert atmosphere during hazardous conditions.
- vi) The system shall deliver a cleaning steam flow capable of emptying a tripped mill into the furnace under specific interlocked conditions.

2.28.07 DISTRIBUTION OF PULVERIZED COAL

- i) Pulverised coal pipes from the mills to the burners shall be arranged in view of maximum symmetry, to achieve even distribution to all burners.
- ii) The coal air mixture velocity in the coal pipes shall not be lower than the critical fallout velocity under all conditions of mill operation from start up of Steam Generator onward.
- iii) The fuel pipe shall preferably have no horizontal run and if horizontal run is necessitated due to layout constraints it shall tilt either towards mills or burners.



GUJARAT STATE ELECTRICITY COPRORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- iv) Calculated static loading of each support of the pulverized coal pipes shall be increased by at least 25% to arrive at the design load, to take care of the shock loading, occurring in the pipe work under abnormal conditions of operation.
- v) The individual pulverised coal ducts behind the distributors shall be provided with shut-off devices, which upon shutdown of one mill shall be closed for avoiding the recirculation of the flue gases. Changes of mills load shall not cause any disturbance of the gas and dust flow in the ducts. No unreasonable wear of ducts shall occur.
- vi) The guide plates, wherever provided in the coal pipe, shall be removable and access to them shall be obtained through detachable cover. The guide plates shall be made up of suitable abrasion resistant material.
- vii) Pulverized coal piping shall be ceramic lined with the thickness of not less than 15 mm wherever necessary.
 - a) From mill outlet up to and including 1st bend and two times pipe diameter straight length downstream of first bend.
 - b) All bends between 15° and 30° angle and straight length downstream of the bends equivalent to one pipe diameter.
 - c) All bends 30° and higher and two times diameter straight length downstream of the bend.
 - d) The burner inlet elbow and the pipe piece after the elbow.
 - e) The burner inlet elbow and the pipe piece after the elbow. PF pipe from mill to the classifier (in case of separate classifier). The ceramic material shall have alumina content of not less than 90%. The ceramic lining shall be minimum 15 mm thickness and shall provide guaranteed life of 25000 hrs.
- viii) Purge air connections shall be provided after the mill discharge valve to clean pulverised coal pipes of any deposits etc.
- ix) Provisions shall be made at suitable locations on pulverized coal piping for sampling the pulverized coal. Suitable sampling equipment shall also be provided.
- x) Balancing of Coal/Primary air flow: Contractor shall balance the primary air as well as coal flows in the pulverized fuel pipes such that the minimum PF and PA flow imbalance in the PF pipes from each coal pulverizer does not exceed 5% of average flows. The above balancing shall be checked by the Contractor by carrying out both clean air test and dirty air test (using dirty pitot tubes). (sampling shall be done as per ISO 9931, ASME PTC 4.2, etc). Bidder shall have to supply complete instrument set of CAVT & DAVT with its spares to GSECL
- xi) Suitable devices shall be provided in each pulverized coal pipes to enable on load adjustment for equalizing flow.
- xii) Bidder scope shall also include supply of dirty Pitot tube for checking on line pulverized coal/primary air flow balance between PF pipes of each mill. The dirty Pitot tube should also have a fast lock/ snap lock arrangement & shall be capable of working in conjunction with motorized probe sampling system specified. It should be supplied complete with a combined pressure & temperature measuring hand held digital instrument, showing also fuel pipe air velocity etc. & with facility of data transfer



through blue tooth from the instrument to control unit. Necessary technical details/calibration curves of the Pitot tube shall be furnished. The number of dirty pitot tubes provided for Steam Generator shall be equal to at least the number of PF pipe outlets from one coal pulveriser.

- xiii) On line fuel measurement facility for accurate measurement of coal mass flow rate/air fuel ratio in each pulverized fuel (PF) pipe for coal pulveriser. The equipment shall comprise of sensors working on micro wave technology. The error in measuring. For the purpose of the above fuel measurement, each PF pipe shall be provided with two no's of tapping points of suitable size, with necessary plugs/dust proof dummies etc. as required.

2.28.08 PULVERIZED FUEL BURNERS

i) *Burner Design*

- a) Coal firing system shall be designed for specified turn-down ratio.
- b) The coal burner design shall ensure a steady log mean density of coal air mixture distribution as it enters the combustion zone, without allowing the coal dust to settle down.
- c) The burner design shall minimise erosion.
- d) The burner shall be designed to ensure smooth variation in the fuel flow without affecting the air to fuel ratio.
- e) The air to fuel ratio around the burner shall be optimized to ensure low emission of NOx. Total NOx emission from the unit at SCR inlet shall not be more than 325 mg/Nm³ at 6% O₂ content on dry basis (fuel as well as thermal NOx) from 40% to 100% TMCR load condition for the entire range of coals specified.
- f) Burners shall be provided with automatic control with flame scanner and safety protection.
- g) Each burner shall be provided with its own igniter and flame scanner. The burners shall be robust and shall stand long operation periods. Adequate measures shall be taken to protect coal burners which are not in operation from being damaged by radiation of heat coming from the furnace. Necessary cooling arrangement shall be provided for non operating burners.

ii) *Burners Construction*

- a) Each coal burner shall be served by one separate coal pipe and shall be provided with one knife edge type gate valve at burner inlet. The valve shall be power operated and hooked up to burner management system.
- b) Compartmented wind box shall be provided for supply of secondary air for combustion.
- c) The material and construction of burner shall withstand radiation from the furnace, and shall not be damaged when not in use.
- d) Burner design shall ensure freedom from deposits and distortion under all operating condition in the furnace. Further, burners shall not require adjustment to maintain flame shape.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- e) The parts subjected to high temperature which cannot be protected by other means shall be made of alloy steel. Further, burner parts subject to abrasion that may require replacement at frequent intervals shall be easily removable.
- f) Minimum operating life of burner parts without requiring any maintenance and replacement shall be guaranteed for minimum 8000 hours.
- g) Burner shall be removable or replaceable from outside the steam generator without entry to the furnace.
- h) Air register construction shall be such that tangential air vanes are always free to move. The support bearings shall preferably be located outside. In case the support bearings are located inside, minimum period of operation shall be 16000 hours without calling for maintenance of any sort during this period.

2.29.00 Coal Bunker

2.29.01 Bidder to provide adequate numbers of coal bunker and should have 16 hrs storage capacities for 100% BMCR operation, taking 20% filling factor considering Performance Coal as fuel.

2.29.02 Fuel storage bunkers with supporting structure complete with emptying chute, poking holes. SS lining of 3 mm thick shall be provided in bottom conical portion plus up to 3 m in cylindrical portion of the bunker.

2.29.03 Permanent bunker emptying chute from bunker shall be provided at each R.C. Bunker outlet and at RC feeder outlet to facilitate fast bunker evacuation. The bunker emptying chutes shall be up to a location where it can directly empty the bunker on a truck at ground level. An arrangement with a temporary chute fitted on the bunker downspout along with a permanent chute from the feeder floor to the ground level is also acceptable. For this purpose at least two numbers of temporary chute per Steam Generator for connecting bunker outlet to permanent chute (to be provided from each RC feeder outlet) shall be provided. Necessary handling/lifting arrangement & suitable platform & approach shall be provided for quick installations and removal of temporary chutes.

2.30.00 Operating Capability of Plant

2.30.01 The operating capability of various systems, equipment and associated auxiliaries in the scope of the Bidder is specified in the Technical Specification.

2.30.02 The plant, its unit and its all auxiliaries equipment/systems shall be designed to operate with all the specified margins for continuous operation without any limitations under any of the conditions indicated in the Technical Specification.

2.30.03 The selection of material for pressure parts shall be suitable for the range of operation as specified.

2.30.04 The major operating capabilities for the unit/plant shall be as follows :

- i) The boiler shall be capable of start-up without HP-LP bypass system in service.
- ii) Boiler shall be suitable for operation in variable pressure operation mode from subcritical to super critical pressure range.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- iii) The boiler shall be designed for minimum rate of loading/unloading mentioned below, without compromising on design of pressure parts:

Step load change	Minimum $\pm 10\%$
Ramp rate	Minimum $\pm 1\%$ per minute (below 50% load to minimum boiler once through load) Minimum $\pm 3\%$ per minute (50% to 100 load)

- iv) Bidder shall clearly indicate in his offer, the maximum rates of loading/unloading achievable, with Boiler offered and the corresponding limiting variations ($\pm\%$) of boiler parameters, such as O₂ in flue gas, SH/RH steam temperature, furnace draft etc.
- v) Boiler shall be designed such that, during ramping, maximum metal temperature shall not exceed the design metal temperature of the material selected.
- vi) Operate continuously with turbine under VWO condition with rated steam parameters, design condenser pressure and 1% cycle make up.
- vii) Sliding Pressure Operation from rated pressure down to 40% of rated pressure with as well as without any throttle reserve. At any operating load, the throttle reserve shall be sufficient so as to achieve an instantaneous increase in turbine output by 5% of the corresponding load, by opening turbine control valves wide open. The throttle reserve shall be 0% for sliding pressure mode of operation.
- viii) Operate continuously with HP heaters out of service with maximum cooling water temperature, 1% cycle make up and normal auxiliary steam requirement being tapped from cold reheat line, to generate maximum output without over stressing turbine components. The power output of the unit under this operating condition shall not be less than 800 MW.
- ix) In case of sudden reduction in demand (load throw off), the unit should get safely unloaded and stabilized for operation at house load with HP-LP bypass open to full capacity. All the components including valve body of HP and LP Bypass valves shall be designed for boiler highest safety valve set pressure due to sudden load throw off under transient conditions.
- x) HP-LP bypass operation under rated steam conditions with bypass valve open to full capacity and turbine on house load.
- xi) Automatic run back capability of the unit load on loss of critical auxiliary equipment (except PA fans), ensuring smooth and stable runback of the Steam Generator and Steam Turbine Generator equipment and systems.
- xii) In case of external disturbances or equipment malfunction, the system shall stabilise itself through proven concepts and controls and within the recommendations of NFPA.
- xiii) Continuous TG output of 800 MW under rated steam conditions, worst condenser pressure, 1% cycle make-up and 47.5 Hz grid frequency.
- xiv) The equipment and auxiliaries shall be suitable for continuous operation in the frequency range of 47.5 Hz to 51.5 Hz.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- xv) Unit shall be capable to start up, normal run and shutdown without BRP in service. Start-up without BRP shall be demonstrated by the contractor. The contractor shall submit various start-up curves and SOP to perform start-up without BRP.
- 2.30.05 All the systems/equipment/auxiliaries under Bidder's scope shall be designed to cater to the above operating conditions envisaged for the unit. Unless specified otherwise in the Technical Specification the design should cater to the above operating conditions with adequate margin as per standard practice prevailing in the fossil fired power plants.
- 2.30.06 The plant shall be designed to operate as a base load station. However, continuous operation under two shift and cyclic modes during certain periods is also envisaged. The design would cover adequate provision for quick start-up and loading of the unit to full load at a fast rate. The main plant and its auxiliaries with their controls would be designed to permit operation of the unit on house load without there being any necessity to shut down the unit in the event of sudden loss of total load due to tripping of transmission lines or any other grid disturbances. The design of the plant equipments and control system would permit participation of the plant in automatic load frequency control.
- 2.31.00 **Minimum Load Without Oil Support for Flame Stabilisation**
- 2.31.01 The design of Steam Generator shall be such that it does not call for any oil support for flame stabilisation beyond 30% BMCR load when firing any coal from the range specified including blending imported coal up to 30% by weight, with Indian coals, with any combination of mills/ adjacent mills in service. This shall be guaranteed and demonstrated by the Bidder.
- 2.31.02 The Owner envisages to have following major operating capabilities for the unit/ plant over and above mentioned in 2.30.00:
- The maximum continuous rating (BMCR) of the unit shall be (a) 102% of the steam quantity required to generate power at VWO condition of turbine or 2425 TPH whichever is higher.
 - Sliding Pressure Operating from rated pressure down to 40% of rated pressure with as well as without any throttle reserve. The throttle reserve shall be adjustable to minimum 0% for pure sliding pressure mode of operation.
 - Operate continuously with HP heaters out of service with maximum specified cooling water temp. 1% make up and normal auxiliary steam requirement being tapped from cold reheat line, to generate maximum output without over stressing any of the equipments/components.
 - In case of sudden reduction in demand (load throw off), the unit should get safely unloaded and stabilized for continuous operation at house load.
 - HP-LP bypass operation under rated steam conditions with Bypass valve open to full capacity and turbine on house load.
 - The equipment and auxiliaries shall be suitable for continuous operation in the frequency range of 47.5 Hz to 51.5 Hz.
 - Provision for life consumption/Equivalent Operating Hours (EOH) of critical components due to Creep & Fatigue shall be made available online (display in CCR)



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

for Operating personnel. Also program/measures shall be made available online (display in CCR) to guide the operating personnel for maintenance planning.

viii) Resulting Damage Factor due to Creep-Fatigue interaction shall be made available online (display in CCR) for Operating personnel.

ix) In no case the design life of Turbine-Generator system shall be affected due to

a) Fatigue Damage resulting from

1. The number of Cold start up, Warm start up and Hot start up as defined elsewhere in the specification and
2. Load cycling during defined plant life.

b) Creep damage

1. The combined creep fatigue damage shall lie within acceptable limits._

2.31.03 Steam Generator(s) and all the equipment and auxiliaries under this package shall be designed to cater and enable to the above operating conditions. Unless specified otherwise in the detailed technical specification, all the equipment and auxiliaries shall be designed to cater to the above operating conditions with adequate margin as per standard practice prevailing in the fossil fired power plants.

2.32.00 **Soot Blowing System**

2.32.01 A complete system for on and off load cleaning of the Steam Generator heating surfaces shall be provided. The cleaning installation shall meet the requirements for coal and heavy fuel oil operation of the steam generator.

Sl. No.	Item	Description
1.	For furnace chamber	Short rotary, single nozzle, retractable type
2.	Vertical pendent section	Two nozzles in diametrically opposite side, long retractable type
3.	Bottom part of gas path between furnace rear wall and back pass front wall	Long multiple nozzle retractable type (Bottom part of this gas path shall inclined at an angle more than 45 degree to horizontal).
4.	For horizontal	Long rotary, multiple nozzle exchanger sections (rear pass) retractable type
5.	Air pre- heaters	Long retractable multi-nozzle soot blower for regenerative air preheater

2.32.02 The scope shall include soot blowers for the regenerative air-heaters and for heating surfaces (Furnace, convective and radiant heating surfaces, and economizers) complete with pipe work, supports, relief valves and all other equipment necessary to maintain the unit in a clean condition for efficient operation. For regenerative air preheaters soot blowers shall be provided on the cold end and Complete washing installation shall be provided. Washing water hoses and supply lines for Off load cleaning of heating surfaces shall also provided

2.32.03 The soot blowers shall be capable of selective operation in areas of ash deposition (SMART type) or equivalent.

	GUJARAT STATE ELECTRICITY COPORATION LIMITED	VOLUME - III
	1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE AREA AT UKAI TPS	PART - A
	BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01	SECTION - 1
	TECHNICAL SPECIFICATION STEAM GENERATOR & AUX. INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx & MRHS	REV. - 0

- 2.32.04 The numbers of soot blowing cycles shall be three per day as a maximum. Soot blowing shall be possible at any load of the steam generator. Design of soot blower shall be of self draining type.
- 2.32.05 Sufficient provision shall be provided for soot blower at water wall and second pass for the installation of future additional soot blowers.
- 2.32.06 All the equipment shall be provided and designed to the requirements of pressure parts and piping specifications wherever applicable. Provisions shall be made in the pipe work for fitting pressure gauges to enable pressure to be observed when soot blowing in order to make any necessary adjustments.
- 2.32.07 Retractable electric motor-driven soot blowers shall be of sufficient number and located so as to enable the Steam Generator to maintain full load, steam temperature and Steam Generator efficiency. The soot blowers shall be the retractable gun and/or lance type to suit the location.
- 2.32.08 Soot blowers shall be retractable even during emergencies such as drop in steam supply pressure, low steam flow, etc.
- 2.32.09 Soot blower control system shall be provided for automatic sequential operation of soot blowers, soot blower steam pressure control and drain temperature control etc. Indication of completion of soot blowing shall be provided on the unit control panel. All soot blowers shall be capable of convenient remote and local manual operation under emergency conditions. Complete automatic control equipment with cubicles arranged for automatic sequence control, remote control and indication shall be supplied for installation in the control room.
- 2.32.10 Control switches shall be provided for each soot blower in order that any blower may be selected in sequence or out of sequence, as may be required. Also the necessary steam supply valves shall be remotely controlled.
- 2.33.00 **Safety Valves / Pressure Relief Devices**
- 2.33.01 The number, size, location and setting of safety valves on separator/on outlet pipeline, superheaters and reheaters shall be as per IBR/ASME. The safety valves, installed on the Steam generator separator, super heater outlet and reheater shall be set to blow in a predetermined sequence.
- 2.33.02 The safety valves of adequate capacity and setting pressure shall be provided on all steam lines including soot blowing lines, auxiliary PRDS lines and the steam lines, wherever pressurisation may take place.
- 2.33.03 safety valves and relief valve shall have minimum discharge capacities as under
- i) Spring loaded safety valves:
 - a) Separator & Superheater Combined capacity - 105% BMCR.
 - b) Reheater System Combined capacity - 105% of reheater flow at BMCR
 - ii) Electromatic Relief Valve)/ Electromatic ball valve(EBV) at:
 - a) Super heater outlet - 15 %BMCR
 - b) Reheater outlet - 20%of Reheat flow at BMCR



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 2.33.04 Electormatic relief Valves shall be provided for Super heater. Electormatic relief valve is set to operate at a lower pressure than spring loaded valves and reduces spring loaded safety valve maintenance substantially.
- 2.33.05 Capacity of electormatic relief valves shall be 15% BMCR for super heater.
- 2.33.06 Two (02) nos. Electormatic relief valve of suitable capacity at reheater outlet (each side 2 nos. i.e. Left & Right) shall be provided to overcome ex-foliation in Reheater. (Over & above conventional safety valves).
- 2.33.07 All equipment necessary for gauging the safety valves and for hydraulic test purposes shall be supplied. Hydro plug shall be provided for all safety valves during hydro test.
- 2.33.08 Set points of H.P. bypass stations and safety valves in the H.P. system shall be selected, so that the H.P. bypass reducing stations will open first. During a trip of the turbine at full load and availability of the H.P. bypass reducing station, no safety valves on the H.P. side shall open.
- 2.33.09 The set pressure of the reheater safety valves and of the low pressure bypass stations shall be chosen so that opening of the reheater safety valves will be avoided to the largest possible extent.
- 2.33.10 The noise level during lifting of safety valves of separators, superheaters and reheaters shall not exceed 105 dBA with the provision of silencer on the first lowest and second lowest set pressure safety valve. Noise level of HP & LP bypass valves shall not exceed 115 dBA during valve operation.
- 2.33.11 Safety valves shall have access platforms of adequate size to permit two people to work with access ladders and maintenance access walkways for reaching the platforms.
- 2.33.12 Access shall be provided on both sides of safety valves.
- 2.34.00 **Auxiliary Steam System**
- 2.34.01 Unit shall consist of Auxiliary steam system with pressure reducing station (PRS) and a desuperheater on the steam line tapped off from the main steam and cold reheat line.
- 2.34.02 The system shall be complete with the pressure reducing valves, bypass valve and isolation valves; safety relief valves, drains, steam traps; quick closing block spray valve; desuperheaters; steam temperature control valves, bypass valve and isolation valves; complete piping, supports with hangers, insulation; and instrumentation and control.
- 2.34.03 Pressure control valves shall be selected in such a way that it would be possible to regulate the steam flow based on demand under all operating regimes.
- 2.34.04 The main header can be divided in to two headers i.e. one high temperature / high pressure header and one low temperature / low pressure header. Bidder shall furnish the basis of the same during detailed engineering for approval.
- 2.34.05 The spray water for desuperheating station shall be supplied from boiler feed pump discharge or inter-stage tap-off. The bidder shall provide pressure and temperature control valves to meet the requirements of auxiliary steam system.



GUJARAT STATE ELECTRICITY COPRORATION LIMITED

VOLUME - III

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AREA AT UKAI TPS**

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BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

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TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

2.34.06 Auxiliary steam system of the proposed plant shall meet from auxiliary boiler supplied by bidder.

2.35.00 Insulation and Cladding

2.35.01 Thermal insulation and cladding has been provided for the entire steam generator, flue gas / air ducting, ESP, etc. Complete thermal insulation including cladding, lagging, reinforcement, wire mesh, cleats, supports etc. will be furnished so as to maintain outside surface temp. of 60 deg C with design ambient temp. of 40 deg C.

2.35.02 Air tightness test up to ESP inlet must be carried out before start of insulation work.

2.35.03 Thermal insulation and cladding for valves, pipes, fittings shall be of the same construction and manufacturer as for the equivalent components used in all other sections of this specification.

2.35.04 The steam generator shall be provided with **1.2 mm** corrugated aluminium cladding and the ducts shall be plain aluminium cladding.

2.35.05 All cladding sheets shall be provided with moisture barrier.

2.35.06 All insulation shall be on-inflammable, hot-resistant, chemically inert and shall remain so in the event of being saturated with water.

2.35.07 The use of asbestos and of glass wool as an insulator is prohibited. The thermal insulation shall consist of preformed slabs or blankets.

2.35.08 The whole outdoor insulation and cladding must be completely sealed as a protection against atmospheric conditions.

2.35.09 Insulation and cladding shall be fitted so as to allow thermal expansions of the equipment, specially piping, without suffering any damage.

2.35.10 Fittings, valves and pipe flanges shall be insulated with material having at least the same thickness and insulating qualities as the material employed on the corresponding pipes.

2.35.11 A small hole to act as a leakage indicator shall be formed in flange lagging. All equipment susceptible of noise emission (e.g. fans, pressure reducing stations, etc.) shall be provided with sound insulation.

2.35.12 All pipes, ducts and other equipment on which condensation on the outer surface is liable to occur, shall be provided with condensate water insulation.

2.36.00 Chemical Dosing System

2.36.01 It is proposed to adopt All Volatile Treatment (AVT) during start-up. During start up, Ammonia dosing is envisaged in the condensate to maintain pH. Oxygenated treatment (OT) will be adopted during steady state operation. Ammonia will be dosed to the condensate system to maintain pH and gaseous oxygen to both condensate and feed water system to maintain residual oxygen. Accordingly, steam generator shall be provided with chemical dosing system.

2.36.02 Ammonia dosing system shall be provided to ensure chemical conditioning of condensate/ feed water for controlling the alkanities. The ammonia solution shall be injected in to the condensate at the condensate extraction pumps discharge.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

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INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 2.36.03 The system shall consist of one solution preparation tank and one solution dilution tank (if required), 2X100% dosing pumps complete with suction/ discharge valves, Y type suction strainers, pressure gauges etc., dosing pump discharge header sectionalizing valves and complete piping with isolating and non- return valves as required.
- 2.36.04 Each tank shall be complete with motorized agitator, overflows and drain connections, inlet / outlet isolating valves and side mounted level gauge / level switch with connecting isolating valves.
- 2.36.05 Oxygen (O₂) dosing system shall be provided to inject oxygen in the main condensate. Bidder shall provide necessary oxygen bottles, manifolds, piping, necessary valves. All the bottles will be placed at a suitable place
- 2.36.06 Other treatments as per Boiler manufacturer's recommendations shall also be supplied.
- 2.36.07 Necessary PPEs required for ammonia handling and safety equipments shall be provided by bidder.
- 2.37.00 **Washing Installations for Heating Surfaces**
- 2.37.01 The selection and supply of equipment for washing of the steam generator shall meet the following requirements:
- 2.37.02 Equipment and washing process shall be chosen, with regard to a minimum demand of service water. All relevant hoses, washing water utility stations at various Steam Generator platforms, connecting pipes and/or pumps (if required) from the water supply source to the utility stations and drainage ducts shall be provided under this contract.
- 2.37.03 For the regenerative air preheaters a fixed installed washing system shall be provided, which must be suited to wash one of the air pre-heaters when the unit is in operation. Regenerative air heaters shall be supplied and designed to permit off-load washing. The system shall include all supply pipes, pumps dosing system, discharge pipes, dust separator complete with internals, discharge ducts and pumps (if required) from the dust separator. Dust separator may be carried out from concrete also, provided that the relevant cooling water connections exist.
- 2.38.00 **Boiler Filling System**
- 2.38.01 2x100% Boiler fill pumps along valves, piping etc. shall be supplied. The boiler fill pump shall draw water from the condensate storage tank (CST) and fill the boiler unit before start-up.
- 2.38.02 The Bidder shall provide boiler fills connection to the boiler unit at economiser, and superheater drain headers. In addition, the fill pump discharge shall be connected to deaerator feed storage tank and ECW storage tank also.
- 2.38.03 The capacity of the fill pump shall be enough to fill the boiler unit in about 2 hour's time.
- 2.39.00 **Blow Down System**
- 2.39.01 The atmospheric flash tank shall be designed to accommodate the following:
- i) Atmospheric tank shall be located at suitable level in the Boiler area



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- ii) Maximum possible start-up recirculation & drain flow under all possible normal, abnormal, upset, accidental conditions and even with start-up recirculation pump out of service.
- iii) All drains from Boiler, such as drains from water wall headers, attemperators headers, SCAPH drains, soot blowers drains, SH, RH etc.
- iv) Alternate drains from main steam lines, CRH lines, HRH lines, as required.
- v) Any other drains from HP piping
- vi) For sizing, combination of all the above occurring simultaneously to be considered.
- vii) Feed water line from HPH outlet to condenser (before economizer) shall be provided.

2.40.00 General Requirements

2.40.01 VIBRATION AND NOISE LEVELS

The design of steam generator and its auxiliaries shall ensure maintaining vibration and noise levels within the limits specified in the following paragraphs over the entire operating range and during load fluctuations.

- i) The gas path design shall prevent the generation of excitation forces conducive to resonant vibration. Adequate spacing of heat transfer surfaces shall be provided in the gas path to ensure that within the allowable vibration limits no rubbing between tubes or between tubes and supports occurs. If necessary, baffles may be introduced.
- ii) ID fans, BFPs, Steam turbine generators shall have vibration isolation system. For other constant speed motors and fans conventional block / frame type RCC foundation shall be provided.
- iii) For Coal mills, ID, FD, PA the vibrations at the bearings shall meet the requirements of ISO 10816 Part 3.
- iv) Vibration isolators of proven performance shall be provided by the BIDDER for preventing transmission of vibrations from one equipment to the neighbouring equipment and structures.
- v) The ducting shall be adequately stiffened to absorb pressure pulsations. Guide vanes shall be provided at bends as required preventing turbulence. Fan/blower induced duct vibrations shall be avoided.
- vi) The measured noise level produced by any rotating equipment shall not exceed the stipulations laid by MOEF.
- vii) The noise produced in valves and piping associated with handling compressible and incompressible fluids shall be attenuated to 90 dBA by the use of low noise trims, baffle plate silencers/line silencers, acoustic lagging (insulation), thick-walled pipe work as and where necessary. All pipes and valves downstream of pressure control valve (including pressure control valve) shall be one schedule higher than needed by pressure considerations to attenuate the noise. For safety relief valves the allowable noise level shall not exceed 115 dBA for one quarter hour or less per day.

	GUJARAT STATE ELECTRICITY COPORATION LIMITED	VOLUME - III
	1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE AREA AT UKAI TPS	PART - A
	BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01	SECTION - 1
	TECHNICAL SPECIFICATION STEAM GENERATOR & AUX. INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx & MRHS	REV. - 0

2.40.02 SAFETY PROVISION

- i) Adequate number of safety valves shall be provided on superheater and reheater headers to safeguard the respective equipment against excess pressure arising out of any emergency. The number and capacity of safety valves shall be as per the Code requirements. All safety valves shall have welded inlet and flanged outlets.
- ii) In addition to the safety valves required by the Code, electromatic relief valve of capacity not less than 10% of 100% BOILER MCR rating, suitable for remote operation shall be provided on superheater outlet header. The valve shall also be capable of automatic operation on rise in separator pressure to a value corresponding to a pressure setting lower than that of the superheater safety valve. Each valve shall be complete with controller, solenoid, pilot valve and piping with two shut-off valves (if applicable).
- iii) All steam safety valves shall be provided with adequately sized atmospheric relief to 1.0 m above the steam generator roof. Weather shields shall be provided at points where the relief pipes pass through the roof. It may be noted that only electromatic relief valve, first spring loaded safety valve and start up vents in super heater first spring loaded safety valve on separator (if applicable) are to be provided with silencers.
- iv) Staircases on either side of mills, and ESP with walkways and galleries shall be provided so that all areas of mills and ESP are safely and conveniently accessible for operation and maintenance.
- v) Staircases shall be provided at front and rear of steam generators to quickly approach various floors. All staircases / platforms shall be provided with 2 rail safety handrails of 100 cm high and made of 32 40 mm GI pipe. All GI pipe hand rail shall be painted with florescent yellow color or florescent strip of yellow color shall be provided
- vi) The minimum width of staircase shall be 1200 mm and the minimum width of platforms shall be 1200 mm. The minimum width of interconnecting walkway between mill maintenance platform and the steam generator gallery shall be 1200 mm. All platforms and staircases shall be provided with gratings and only operating floor shall be provided with chequered plates.
- vii) Actuators for remote operation of shut-off gates at the air inlets to coal mills and shut off gates at outlet of coal mills shall be provided to allow positive shut-off in the event of fire in the mills.
- viii) Staircase of width 1200mm for mill maintenance platform (Left & Right) from FFL shall be provided.

2.40.03 HYDRAULIC TEST

- i) All the components which are to be subjected to fluid pressure shall be tested to minimum of 150% of the design pressure.
- ii) In determining the value of the maximum attainable pressure for any component the Bidder shall take in to account all relevant factors (e.g. safety valve blow off pressure, fluid surges, etc.) which may cause an elevation in the pressure.
- iii) The Bidder shall furnish details of the basis of the calculation of maximum attainable pressure tests.



- iv) The duration of the pressure tests shall be sufficient, as approved by the Engineer, to show any leakage paths and to permit a thorough examination of the component whilst under pressure.

2.41.00 Storage Platform

- i) In addition to maintenance platforms, walkways etc. specified above the Contractor shall provide storage platforms for storing of scaffoldings & APH baskets in accordance with the following:
- Scaffoldings: Platforms around scaffolding entry point for storing of maintenance cradle/quick erected scaffoldings (minimum 50 Sq m of platforms on each side) prior to commencement of maintenance/overhaul activities. Weight of maintenance cradle/quick erected scaffoldings shall be accounted in the structure and platform design.
 - APH Baskets: Platforms (minimum 100 Sq m of platforms) with proper approach near APH(s) for storage of APH Baskets. Weight of stored APH baskets shall be accounted in the structure and platform design.

Note:

- Weight of APH baskets indicated above shall be including the weight of elements.
- Storage platform shall be solely for storage of APH baskets and shall not be part of maintenance/operating platform.
- Platforms together with ladders shall be provided for access to all maintenance hoists.
- Contractor shall ensure that the layout of PF coal pipes is routed in such a way so as to ensure that horizontal sections of PF coal pipes and bends are accessible from the nearest platform or walkway level, to the extent possible, to facilitate replacement of PF coal pipes and PF bends during maintenance. Where direct access from nearest platform/walkway is not possible, Contractor shall provide proper procedure to facilitate Employer erect scaffolding, temporary ladders, platforms and safety nets to safely perform the replacement/repair of coal pipes.
- Maintenance access areas, where access is only required for painting, re-insulation or replacement of components which have a service life of 10 years or more shall have facilities to enable the Employer to erect scaffolding, temporary ladders, platforms and safety nets to safely perform the work involved.
- Platforms of minimum clear width of 1500 mm shall be provided on at least three sides of the control station/ equipment. The platforms shall be all along the length of soot blower control station, Fuel oil control station, SH & RH spray control stations, SCAPH control station, steam/water sample coolers, APH lube oil station etc. Access through Elevator, staircase and main access walkways for reaching the platforms shall be provided.
- Bidder shall provide a common working/maintenance platform in the area of bunker discharge gate, connecting all feeders in each side.
- Bidder shall have to supply Quick erection furnace scaffolding for maintenance work.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

2.42.00 Maintenance Requirements

2.42.01 The bidder shall provide facilities for carrying out on-load and offload maintenance of the steam generator and its ancillaries. In general, this should include adequate handling equipment, working space, platforms and safety devices.

2.42.02 Access doors shall be provided to permit access to the furnace, superheater, the area between the tube banks, economiser and any other areas requiring access. Access doors on both sides of the pass shall be furnished. All access doors provided for furnace, ducts, etc., shall be of minimum 450 mm x 450 mm.

2.42.03 Staircases on either side of the steam generator shall be provided. The angle of the staircase shall not be less than 45 degrees with vertical except in very critical areas. Staircases shall also be provided at the rear of the steam generator in the burner zone connecting burner platforms to enable operators to attend burner at other levels.

2.42.04 In order to carry out on-load maintenance, it is necessary that the equipment supplied can be readily disassembled, repaired and assembled.

2.43.00 Erection

i) Bidder has to carry out Radiography as per IBR i.e. 10% (5% each from DHT&NDHT) and Radiography/PAUT of additional 10% (5% each from DHT&NDHT) of total joints (Total 20% including IBR requirement)

ii) PAUT shall be carried out for balance 80% joints of NDHT.

iii) 100% joints Hardness measurement of P91&P92 grade material joints shall be carried out by UCI technique.

iv) PAUT technique shall be used instead of conventional UT for all piping weld joints.

2.44.00 Before COD, all headers should be checked & verified by video graphic baroscopic examination.

2.45.00 Hoists and Trolleys

2.45.01 For the equipment which weighs above 1000 kg, electrically operated type of hoists (chain pulley blocks) and trolleys shall be provided. For equipment weighing less than 1000 kg, manually operated hoists shall be provided. All blowers/fans/motors, gear boxes, etc. shall be provided with hoists and trolleys for maintenance purposes.

2.45.02 Refer Cranes & Hoists specification, Vol.-III, Part-A, Section-9, for more details.

2.46.00 Elevators

2.46.01 Refer Elevators specification, Vol.-III, Part-A, Section-15, for more details.

3.00.00 DE-NOX SYSTEM (SCR)

3.01.00 Design Basis

3.01.01 Sufficient catalyst shall be provided to treat the exhaust gas to meet emission levels specified without requiring cleaning (except soot blowing). The SCR system shall not require the steam generator to be shut down, during the normal course of operation, for catalyst cleaning.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

3.01.02 SCR system shall be designed and engineered as follows:

- i) The flue gas flow from the economizer passes through the 2x60% BMCR capacity SCR catalyst & reactor and subsequently sent to the air heater. The ammonia/air mixture from the dilution skid will be injected through the ammonia injection grid upstream of the SCR catalyst. SCR system shall be designed and engineered such that: It is placed in the flue gas path between economizer and air heater. Inlet and outlet of each 60% BMCR capacity SCR section shall be provided with dampers to ensure maintenance of a section keeping another section in operation.
- ii) The system designed and supplied shall ensure to meet emission conditions as maximum NOx emission (thermal as well as fuel) measured as NO₂ from the Steam Generator unit shall not exceed 90mg/Nm³ (at 6% O₂ level and dry basis) during the entire operating range of steam generator for the range of coal specified or latest MOEF guideline whichever is more stringent. SCR system shall be designed for 100% BMCR continuous operation provided the minimum catalyst inlet temperature required for ammonia injection is maintained. The system shall be designed considering the impact of ash loading and characteristics of fuels as specified elsewhere in the specification.
- iii) Bidder shall optimize the reactor design so the ammonia slippage value shall be reduced to minimum. The bidder offer shall clearly indicate maximum ammonia slippage value acceptable and after which catalyst module needs replacement.
- iv) Ammonia slippage value shall not exceed 2 ppm under all operating conditions and range of coal specified
- v) Note: The SCR reagent will be delivered to the site in tank via truck equipped with unloading pumps or compressors as applicable. The bidder shall have proper arrangement for receiving facilities considering the transport management.
- vi) Corrosion-resistant materials and suitable protective linings or coatings wherever required shall be provided as per standard and proven practice of the bidder with suitable corrosion allowance. Equipment handling anhydrous ammonia (if applicable) shall comply with the requirements of ANSI K61.1
- vii) Copper or copper-bearing materials in any part of the SCR system in contact with ammonia shall not be provided.
- viii) The piping system shall comply with the requirements of ASME B31.1. The piping material shall be of ASTM A106 Gr. B. PWHT of carbon steel piping and tanks shall be done if anhydrous ammonia is used.
- ix) Pressure loss of the equipment shall be designed in consideration of future provision of additional catalytic blocks for DeNOX performance.

3.01.03 SCR CATALYST AND MODULES

- i) Monolithic substrate, plate-type catalyst required considering very high dust load in the flue gas. Loose or pelletized catalysts shall not be provided.
- ii) Enough strength and durability physically, chemically and thermally for long time use conforming to the DeNOX equipment inlet gas characteristics. The life of catalyst module shall not be less than 20,000 hrs. of continuous operation under any operating condition and range of coal specified.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- iii) Non-degraded in performance due to flue-gas injection to reactor without ammonia below a lower limit temperature.
- iv) Catalyst shall be arranged so as to avoid gas drift, ash contamination and flue gas bypass.
- v) Catalyst casing shall be acid-proof, wear-resistant and heat-resistant material.
- vi) Provide suitable transitions and flow straighteners at both ends of the SCR to minimize the pressure loss.
- vii) Sample blocks or removable sections of catalyst on the front face shall be provided so that laboratory tests on sample blocks may be used to predict the remaining active life of the catalyst. At least four sample blocks per module shall be provided.
- viii) Suitable lifting devices attached to each self-supporting module within the reactor housing shall be provided.
- ix) Suitable screen shall be installed in each module, above the catalyst elements, to prevent large ash particles from reaching the catalyst surface. The screen shall be designed to withstand personnel walking on it.
- x) Catalyst shall be shop assembled into standard size module consistent with the duct cross section and shipping clearance. Module type catalyst dimension shall facilitate installation into and removal from the reactor housing.
- xi) Design Features of Catalyst Module
 - a) Bidder will provide the following design features for the catalyst as minimum:
 - b) Minimize leakage of untreated gas past a module.
 - c) Absorb thermal expansion/contraction of the catalyst arrays/modules without subjecting the catalyst, internal support members, or converter housing to excessive stress levels while heating up, operating, or cooling down during all modes of steam generator operation specified.
 - d) Design the catalyst modules to permit inspection of catalyst and reactor interior without damaging the catalyst.
 - e) SCR reactor design shall be suitable for accommodating all catalyst types for both current and future catalyst installation. Bidder shall use standard size modules so that alternate catalyst types or manufacturers can be used in the future without adverse effects.

3.02.00 SCR Reactor

- 3.02.01 Material and structure and shall be designed to withstand the flue-gas properties in the reactor and high temperatures.
- 3.02.02 Structure and capacity suitably designed to consider the future catalyst addition.
- 3.02.03 Equipment piping etc. shall be easily removable for maintenance and inspection.
- 3.02.04 Catalyst replacement facilities shall be capable of loading/unloading safely and efficiently with electric hoist.
- 3.02.05 Manhole shall be provided to carry out internal inspection of the reactor and catalyst replacement.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

3.02.06 Self-supporting structure shall be provided for the catalyst modules with Sealing in between the modules.

3.02.07 DESIGN FEATURES OF SCR REACTOR

- i) Not to be damaged due to thermal stress caused by temperature changes including start and stop of the steam generator.
- ii) Designed for lower draft loss in the reactor structure as much as possible.
- iii) Thermal insulation shall be provided directly over outer surface of reactor iron skin.
- iv) Note: Platform, stairs and approach shall be provided to carry out DeNOX catalyst addition and replacement work.
- v) Designed for high dust conditions (generated by specific coal) to avoid flue-gas drift, accumulation of dust and wear.
- vi) Designed to avoid ash gathering spot.
- vii) Hoppers (if required) shall be provided to collect ash with valley angles not less than 60 degrees from the horizontal.
- viii) Soot blower/ sonic horns shall be provided to clean the catalyst surfaces as required as per standard and proven practice of the bidder.

Note: Catalyst modules shall be arranged in at least two layers. Provision for future addition of one more layer shall be provided. Reactor frame shall accommodate future installation of this additional layer of catalyst without any further structural modifications.

3.03.00 **Control & Instrumentation**

3.03.01 NOX concentration analyzers shall be provided in the inlet and outlet of Reactor for controlling and catalyst management so as to monitor the concentration remotely at control room.

3.03.02 Unreacted ammonia concentration indicator shall be installed in the outlet of Reactor for monitoring so as to monitor the concentration remotely at the control room.

3.03.03 Other Instruments (Remote & Local) shall also be provided by bidder as per process requirements as approved by owner.

3.04.00 **Ammonia Injection Grid (AIG)**

3.04.01 Ammonia Injection nozzle shall be

- i) Equipped with appropriate gas concentration, location and quantity, considering the distance to the follow velocity distribution at all operating condition. Flow regulating valve shall be provided in the supply pipe for controlled supply of ammonia for denitrification facility.
- ii) Able to control and adjust the ammonia injection rate for each nozzle. The injection grid shall uniformly distribute the ammonia/air mixture into the flue gas stream. The grid shall be divided into multiple branches consistent with the flue gas duct size and configuration, with a common supply header feeding each branch. Bidder to submit proven operational experience with the proposed ammonia injection grid system.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- iii) Structured to avoid unbalanced ammonia injection caused by ash deposition, clogging and abrasion.
- iv) Equipped at the location for easy inspection.
- v) With Stainless steel material for the various components of the injection grid located in the flue gas stream. The common supply header and riser pipes outside the flue gas stream shall be of carbon steel (ASTM A106, Grade B) material.
- vi) Provided with flow-regulating system for each individual grid branch.
- vii) Air and Ammonia flow monitoring devices shall be provided.
- viii) Unit DCS shall be used to regulate AIG system in accordance to Boiler load, Inlet NOX concentration, and inlet gas temperature and shall be used as feed forward signal to use the Ammonia Injection Rate. The feedback from SCR outlet NOX concentration can be used to control the Ammonia Injection rate. Local Control Panel with GIU shall also be provided by bidder for AIG system.
- ix) Provided with proper supports for the injection grid taking into consideration thermal stresses and vibration caused by the flue gas flow.

3.04.02 Ammonia supply piping shall be able to be isolated safely during inspection.

3.04.03 Ammonia leak detector and warning light shall be provided nearby Ammonia Injection nozzle area. In case of ammonia leakage, remote indication shall be monitored in control room.

3.04.04 N2 purge line shall be positioned in the Ammonia pipe line

3.04.05 Ammonia density after dilution and mixing shall be controlled with appropriate dilution air quantity suitable for safe and efficient operation at all operating conditions.

3.04.06 Ammonia slip monitoring instruments shall be provided between SCR and Air Heater, in order to maintain the permitted levels of Ammonia Slippage. The catalyst layer cleaning can be carried out based on this.

3.05.00 Ammonia Vaporisation and Dilution System

3.05.01 Fully skid-mounted ammonia vaporisation and dilution system shall be provided including piping & instrumentation. Electrical and controls system shall comply with the requirements as specified elsewhere in the specification.

3.05.02 Electrically heated air to vaporize and dilute ammonia in vaporisation/mixing chamber. Bidder may provide any alternative scheme as per their standard and proven practice.

3.05.03 Ammonia shall be properly mix with air so that the gas mixture is safe and non-flammable and meets applicable NFPA requirement handling ammonia/air mixtures. Static type mixing chamber shall be provided as per standard and proven practice of bidder.

3.05.04 2 x 100% air blowers (1W +1S) to supply the dilution air shall be provided. The blowers with sufficient pressure to efficiently inject the ammonia/air mixture into the flue gas stream in accordance with the pressure and flue gas volume. Belt-driven blowers shall not be provided.

3.05.05 Alternatively Bidder may offer connection from FD fan outlet header for dilution air as per their standard and proven practice.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

3.05.06 Additional Features

- i) Air and ammonia piping and supports required to interconnect the various components on the skid shall be provided. The material of construction shall of A106 Gr.B for ammonia piping.
- ii) Suction silencer and air filter shall be provided at blower inlet. Provision for detection of excessive pressure drop shall be provided with alarm. The filter shall be cleanable and reusable type.
- iii) Ammonia/air vaporisation and mixing chamber of suitable material shall be provided for the service conditions.
- iv) Valves, such as safety valves, isolation valves, non-return valves, and control valves, required to operate, maintain, and control the equipment shall be provided.
- v) Flow meter shall be provided to measure actual ammonia flow rate. Pressure and temperature and all other instrumentation required to safely and properly operate the system shall be provided as specified elsewhere in the specification.

3.06.00 Ammonia Storage Tank

- 3.06.01 Storage tank(s) having 15 days storage capacity of reagent usage shall be provided considering steam generator 100% BMCR operation.
- 3.06.02 If multiple tanks are considered than limit switches on valves shall be provided to indicate which tank is in service.
- 3.06.03 If anhydrous ammonia is considered, storage tank shall be of all-welded steel construction. The tank shall be designed, fabricated, and tested in accordance with ASME B&PV Code Section VIII. The tank design pressure shall be suitable for the duty condition with appropriate margin. PWHT of carbon steel piping and pressure vessels (including tanks) shall be provided.
- 3.06.04 Ladder shall be provided on one side of the tank. Platforms for access to all valves and maintenance items shall be provided.
- 3.06.05 Provide 600 mm diameter (minimum) manhole in the tank.
- 3.06.06 Provide tank with 1.6 mm corrosion allowance over and above the thickness as determined by applicable codes.
- 3.06.07 Vapour pressure relief valve shall be provided to protect the tank from pressures in excess of the design working pressure.
- 3.06.08 Manually operated drain valve shall be provided to remove ammonia for maintenance of the tank.
- 3.06.09 Ammonia tank shall be equipped with Level and Temperature instruments for local and remote monitoring.
- 3.07.00 **Ammonia Unloading Compressors (for truck unloading) (as applicable)**
- 3.07.01 2 x 100%(1W+1S) skid-mounted ammonia unloading compressors, complete with motor drives.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 3.07.02 The unloading compressors shall be of double-seal, oil-free, piston type. The system shall be designed to unload ammonia from a truck tank trailer to the storage tank in less than 4 hours.
- 3.07.03 Isolation valves at each compressor inlet and outlet and in each recirculation line, and none- return valve at each compressor outlet and in each recirculation line shall be provided along with safety relief valves (if required) and required instrumentation.
- 3.07.04 Each ammonia system shall be provided with two independent compressor suction and discharge points, with the required inter connecting piping to allow operation with one or two compressors.
- 3.08.00 **Aqueous Ammonia Feed Pumps (as applicable)**
- 3.08.01 2 x 100% (1W+1S) skid-mounted ammonia feed pumps, complete with motor drives.
- 3.08.02 Positive displacement feed pumps shall be provided with recirculation back to the storage tank. Regulating valve in each pump's recirculation line shall be provided to facilitate control of ammonia flow to the system. Flow control valve and all required instrumentation in the ammonia supply piping shall be provided.
- 3.08.03 Isolation valves at each pump inlet and outlet and in each recirculation line, and non-return valve at each pump outlet and in each recirculation line shall be provided along with safety relief valves (if applicable).
- 3.08.04 Each ammonia system with two independent pump suction and discharge points shall be provided with the required interconnecting piping to allow operation with one or two pumps.
- 3.09.00 **Safety Precaution**
- 3.09.01 Safety measures in ammonia handling and vaporisation system shall include the following (as minimum):-
- Protection wall shall be provided in the area of Ammonia (NH₃) storage tank and vaporisation system.
 - Local and remote alarm and monitoring system shall be provided for NH₃ detection.
 - Water shower facility shall be provided in NH₃ area to rinse human eye and body in case of emergency.
 - Water spray system shall be provided in NH₃ area and piping for protection in case of NH₃ leakage.
 - Protection wears (2 sets) shall be provided, which shall include protection suit, gloves, air cylinder and glasses.
- 4.00.00 **DUST PRECIPITATION AND COLLECTION SYSTEM (ELECTROSTATIC PRECIPITATOR) - ESP**
- 4.01.00 One electrostatic precipitator (ESP) shall be provided for the steam generator and shall be designed to limit the dust concentration below 25mg/Nm³ (at 6% O₂ and dry basis) at ESP outlet with the specified range of coal firing and with of each stream out of service. All the fields of ESP shall be normally in service. ESP shall provide with at least six(6) streams per boiler with equal / uniform flow distribution through each stream and minimum seven (7) fields with one field standby at BMCR worst coal firing.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 4.02.00 The electrostatic precipitator shall be complete with supporting structural frames, collecting and discharge electrodes, shaft insulators, bush insulators, independent rapping system for collecting and discharge electrodes with automatic rapping controls, high voltage transformers, rectifiers, bus sections with sectionalising and grounding switches and controls, fly ash collecting hoppers with accessories etc. An Energy Management System (EMS) shall be provided to optimise the power consumption. The Bidder shall furnish the details of EMS.
- 4.03.00 For personnel protection, key interlocks shall be provided to prevent the opening of any inspection and/or access doors until after de-energising of all high voltage equipment that can be reached and/or made contact with, through the inspection and/or access door.
- 4.04.00 Each hopper shall be provided an arrangement to facilitate emergency poking. The hoist with supporting structure/beams to permit easy removal of each transformer-rectifier from its operating position to grade level shall be provided.
- 4.05.00 The rapping system shall be designed for selective remote automatic or manual operation at adjustable intervals. Necessary rapping arrangement with controls shall be provided for perforated gas distribution plate at inlet to the ESP.
- 4.06.00 Adequate number of motor operated guillotine dampers shall be provided by the bidder at inlet and outlet of each section of ESP for their effective isolation to carry out internal repair and maintenance of the isolated ESP section while steam generator is on load. These dampers shall also be furnished with electrical drives for remote/local operation. Absolute gas tightness of the isolation shall be ensured at the seals.
- 4.07.00 The dust collection hoppers at all strategic locations along the flue gas path and those below the ESPs shall have a minimum storage capacity of 8 hours at 100% MCR conditions of the steam generator with worst coal. The hoppers shall have electric heating arrangement to prevent ash sticking to the walls of the hoppers. These hoppers shall be provided with minimum 3mm thick SS liners (SS 304).
- 4.08.00 Access doors of suitable size and shape, platforms and corresponding interior walkways of suitable width shall be provided on each side of the casing before and after each of the fields in series at the bottom and midpoint elevations of the collecting electrodes in order to facilitate maintenance and inspection of each of the fields. They shall be mounted on extended frames to provide for finishing off outside insulation.
- 4.09.00 Emitting electrodes of rigid type (barbed type) may be considered and each hopper shall be provided with heating system, to prevent arching of ash during cold conditions.
- 4.10.00 If the OEM standard design is such that the roof is pierced with rapper rods, high voltage support insulators, or other components which would require that external insulation, weather-proofing, be installed he shall provide a penthouse/weather enclosure to be erected on precipitator roof. If not, he shall provide aluminium gutters, transformers and a 100 cm high 2-rail safety handrail.
- 4.11.00 Penthouse/weather enclosures shall be ventilated by electric motor driven fans. The transformer rectifier sets, controls etc., must be kept within acceptable temperature limits under all operating conditions with maximum ambient temperature. The fans shall be wall mounted, exhaust from inside the penthouse to the outside and be protected with rain louvers.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 4.12.00 The bidder shall supply hoist to permit easy removal of each transformer rectifier from its operating position to grade level. ESP rapping equipment shall be arranged to operate in a manner which remove dust from the discharge and collecting electrodes in a relatively continuous manner in order to eliminate stack puffs. Independent rapping systems shall be provided for discharge and collecting electrodes with independent control systems, to minimise local re-entrainment.
- 4.13.00 The rapping system shall be designed for selective remote automatic or manual operation at adjustable intervals without interface between vibrations caused by excessive raps. Necessary rapping arrangement with controls shall be provided for perforated gas distribution plate at inlet and outlet from the ESP.
- 4.14.00 The electrical insulation of ESP shall be so designed that the internals of each field may be readily replaced by removing the appropriate roof section, without disturbing the high voltage electrical suspension system.
- 4.15.00 Height of hopper bottom flange shall be minimum 3.5 mtr from FFL
- 4.16.00 Minimum distance between two extreme end of Collecting system motors of two passes shall be 0.5 mtrs.
- 4.17.00 Necessary platforms shall be provided for ash level indicators maintenance work.
- 4.18.00 Proper gradient of ESP top floor shall be provided through out the ESP.
- 4.19.00 CAVT shall be carrying out to study flue gas distribution up to the ID Fan before PG Test & after 15000 SG running hours and accordingly necessary modifications/rectifications shall be made if required. (without any extra cost)
- 4.20.00 Air tightness test (ATT) shall be carried out before start of insulation work.
- 4.21.00 **Fly Ash Removal**
- 4.21.01 All points of natural dust deposition including that in second pass below the air preheaters and ESP shall be provided with hoppers of proper shape and size to effectively and efficiently collect the fly ash. The ash hoppers shall be of welded steel construction. The hoppers shall be suitably insulated on the exterior.
- 4.21.02 Each ash hopper shall be provided with a dust tight sealed hinged inspection door and an access door of suitable size. The hoppers shall be provided with the required outlet connections.
- 4.21.03 The size of the hopper is so designed that it will collect maximum ash with lowest calorific value of coal.
- 4.21.04 Fly Ash Hoppers
- i) The ash hoppers shall be designed for an ash density indicated in the data sheet datasheet A. All bracing and stiffening shall be on external side of hopper. No internal bracing, stiffening, etc. shall be utilised.
- ii) The hopper shall be of pyramid shape with plate angle of at least 70 degree with the horizontal with an access door on each side of baffle.
- 4.22.00 **Electrical System of ESP**
- 4.22.01 Transformer Rectifier Equipment



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- i) These shall be suitable for outdoor installation.
 - ii) Transformer-rectifier assemblies shall be designed for electrostatic precipitator service and shall be for single-phase energisation with silicon rectifiers connected for pulsating negative polarity double, half-wave operation.
 - iii) Means shall be provided for changing to full wave operation, if found desirable, for any reason through external switching.
 - iv) The access door to the links, required for changing the high voltage connections, or the high voltage switch operating mechanism or cover shall be arranged for locking with a padlock.
 - v) Key interlocking shall be provided on access door or cover to the links required for changing the high voltage connections or the high voltage switch operating mechanism to prevent access while the transformer-rectifier is energised. HV side of the TR set shall be provided with isolator and earthing switch that can be operated from outside the HV enclosure.
 - vi) Protection against surge, excess temperature rise and under voltage, etc. shall be provided for the TR units. Ambient temperature for design of TR units shall be taken as 50°C. Transformers shall be mineral insulated oil filled type class ONAN cooling type. The transformers and its associated equipment shall conform to IS or other approved international standards (like BS / DIN/JIS etc).
 - vii) Relays and local instruments, such as, Buchholz relay, local oil level gauge, dial type thermometer with alarm & trip contact, pressure relief valve etc. and two nos. marshalling box, one for power and other for protection & control cable entry shall be provided by the Bidder.
- 4.22.02 Each field should have its dedicated TR set. Electrode spacing shall be 400mm with minimum SCA of 180 m²/m³/s.
- 4.22.03 Primary taps shall be included on the transformer. Transformer shall have electrostatic shielding between primary and secondary windings and shall have suitable shielding of the high voltage coil to accomplish proper voltage division in the transformer when unit is subjected to surge conditions encountered in electrostatic fly ash precipitator application.
- 4.22.04 Each output leg of each transformer-rectifier set shall serve one bus section and both bus sections served by each transformer-rectifier set shall be in the same field.
- 4.22.05 Transformer rectifier assemblies shall be mounted in a heavy gauge welded steel tank designed for a minimum of 0.5 Kg/cm² test pressure and full vacuum. Insulating and cooling medium shall be non-flammable insulating fluid. Unit shall be adequately sealed to prevent contamination of insulation and cooling medium. Outdoor type construction shall be used except for the high voltage bushings which shall be enclosed by the bus duct.
- 4.22.06 All silicon rectifier cells shall be conservatively rated for compatibility with maximum circuit load and demand requirements. with proven service record and conforming to relevant IS or other approved international standards shall be provided by the Bidder. The rectifier units shall be suitably arranged to give satisfactory operation at all loads with arrangement to take any one unit off the system without affecting operation of the



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

precipitator. Each TR set shall be placed on a metal tray to collect leakage/spillage oil. All such trays shall be connected to common drain pipe which shall be extended up to ground level with necessary valves. The TR set shall be of approved make having adequate proven experience of use and subject to approval of the Owner. The HV Rectifier set shall preferably be located in a separate chamber, other than the transformer tank, in order to facilitate replacement / maintenance of the diodes. However, designs having HV rectifier integral to transformer tanks are also acceptable. Over current protection shall be provided in case of failure of diodes. Each TR panel shall have a provision of interfacing with ESP control room PC for ON – OFF, data logging, alarm and display, etc. During normal operation, if power fails, the system can be restarted from Workstation (PC) after revival of power. Transformers shall conform to IS:2026 / IEC60076. All other equipment/ accessories shall conform to relevant Indian Standards. Equipment conforming to equivalent International Standard like IEC shall also be acceptable. The transformer oil shall meet the fire safety requirement specified in paragraph 450-23 of National Electrical Code

- 4.22.07 If required suitable low-loss impedance shall be included in the high voltage circuit to limit circuit capacitance discharge current to values compatible with current rating of the rectifying elements used.
- 4.22.08 Supporting insulators shall be located in heated compartments that are maintained above the dew point of the flue gas. They shall be located out of the dirty gas stream. These shall be protected from weather by either a common top housing or individual compartments. A steel shroud below the insulator may be provided which will further inhibit dust diffusion. Each compartment shall be pressurised and ventilated by heated filtered air furnished by one or more motor driven blowers. Contactors and strip heaters with control thermostats for heating the air, blower motors, and blower motor contactors and control for each compartment as required, for complete automatic/manual operation with alarm contacts for high and low temperatures and loss of pressure shall be provided. The filters shall be of the washable type, adequately sized for use in dusty atmosphere.
- 4.22.09 If strip heaters are used, the wiring to the strip heater terminals shall be nickel-plated copper with 600 voltteflon-glass insulation. The Strip Heaters of adequate rating to be provided at two elevations at a distance of 0.5 meter instead of conventional design.
- 4.23.00 **Control Cubicles for ESP**
- 4.23.01 Automatic control cubicles shall be furnished for indoor mounting. The automatic controls shall have full control from 10% of the power set rating to full rating.
- 4.23.02 The control system should be capable of:
- Evaluating sparking by intensity and wave shape.
 - Regulate power at the threshold of sparking.
 - Break a power arc within around ten (10) millisec of its occurrence.
 - Automatically control the arc response so that power is restored within around one hundred twenty (120) millisecs.
 - Modify the current wave shape permitting greater power input prior to reaching spark over threshold.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- 4.23.03 The bidder shall furnish complete control and interlock system to automatically regulate, monitor and provide for safe operation of the ESP.
- 4.23.04 Provision shall be made in each cubicle for auto-manual operation. The control circuit shall be so arranged that when the latter switch is in manual position the ESP control room operator shall be able to control the electrical performance of the ESP by means of a control switch, potentiometer or variable transformers. When the switch is in the auto position, the automatic regulator unit located in the control cubicle shall control the performance of the ESP in accordance with its requirements and settings of the regulator. Manual adjustments of high voltage set points shall be provided.
- 4.23.05 Adequate numbers of indicating instruments shall be provided on the control cubicles for the purpose of correct monitoring of the performance of ESP and accessories.
- 4.23.06 Sufficient numbers of alarms shall be provided on the control cubicles.
- 4.24.00 Rapper control system for each bus section or pairs of bus sections served by a single transformer-rectifier shall:
- 4.24.01 Provide manual adjustments of the timing and frequency of operation and the rapping intensity from the control cabinets.
- 4.24.02 Provide rapper diagnostic system including miniature indicating lights, digital indicators, etc.
- 4.25.00 Drive motors of the rapping mechanism for collecting and discharge electrodes and fans shall comprise 415V, 3 Phase, 50 Hz, rated direct-online induction motors with IP-55 enclosure. In general, motors shall conform to Specification as specified elsewhere in this specification.
- 4.26.00 The BIDDER shall optimise gas flow pattern and distribution in the precipitator sections.
- 4.27.00 The storm water drain piping shall be provided up to the grade level for ESP
- 4.28.00 Fire hydrant arrangement shall be provided at two extreme ends of ESP.

5.00.00 MILL REJECT SYSTEM

5.01.00 System Description

- 5.01.01 The mills rejects (pyrites) discharged by the mills shall be collected in the respective mill's pyrites hopper. The pyrites hopper shall be provided with isolation valves / dampers such that the valve will open automatically after a pre-set weight of the rejects for further conveyance; timer operation should also be provided. The arrangement of the mill reject hopper gates shall be such that at all times atmospheric air shall not ingress into the system.
- 5.01.02 Pyrite hopper outlet spout should be having adequate ground clearance. Adequate maintenance space (as approved by employer) should be provided for various C&I instruments, valves and other equipment of mill reject system.
- 5.01.03 Mechanical conveying system shall be provided for transportation of mill rejects to silo.
- 5.01.04 Each mill shall be provided with mill reject pyrite hopper. Each pyrite hopper shall be provided with vibrating feeder and metallic belt/chain flight conveyor carry mill reject from hopper to Bucket elevator for final storage at Silo.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

5.01.05 Pyrite hopper shall be provided with water spray quenching system to cool down the mill rejects.

5.01.06 Each Mill Bay shall be provided with an independent 'SILO' having a collection capacity of 16 effective hours of mill reject considering all mills of that particular bay are working. Clear head room of minimum 4.5 m below silo outlet shall be kept for truck entry. Each silo outlet shall be provided with sector gate for unloading of mill rejects from silo to trucks.

5.02.00 Design Criteria

5.02.01 Following parameters shall be considered for designing the mill reject handling system:-

1.	Duty	Continuous
2.	Number of mills working per boiler at 100%BMCR (with worst coal)	As mentioned in mill data sheets
3.	Rated extraction rate of mill reject from pyrite hopper	1.5% of coal consumption at 100% BMCR considering worst coal.
4.	Design extraction rate of mill reject from pyrite hopper	20% above rated capacity at 100% BMCR considering worst coal.
5.	Design Maximum size of mill reject to be handled	(-) 40mm
6.	Bulk density of mill rejects for volumetric computation	1600 kg/m ³
7.	Bulk density of mill rejects for loads/strength computation	2400 kg/m ³
8.	Temperature of Mill rejects	200°C or as specified by the boiler/mill manufacturer, whichever is higher.

5.03.00 Equipment and System Specification

5.03.01 PYRITE HOPPER

- Each coal mill has a discharge spout with an Air electric cylinder operated knife gate valve for discharging rejects into a pyrite hopper
- Each pyrite hopper shall be provided with air cylinder operated plate/ dome type valve of approved design at the bottom, adequately sized manhole/ inspection door, impingement deflector plate, sizing grid and emergency chute with manually operated flap gate. Any platform required to maintain the above equipment shall also be provided. Necessary explosion vent of proven design shall be provided in each pyrite hopper.
- Each emergency chute shall be provided with a pneumatically operated gate valve with provision of manual hand wheel to transfer mill rejects from pyrite hopper to ground or to Owner's trolley. The gates shall be of robust construction and suitable for trouble free operation. The lever / gear wheel arrangement for manual operation shall be designed such that minimum effort is required to operate the gate. Necessary access and platform shall be provided.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- iv) Each pyrite hopper shall be provided with two level switches – one for Hi –level and one for low level.
- v) The pneumatically operated plate/knife edge valve shall be provided with provision of manual hand wheel from safety aspect as reject shall be hot.

5.03.02 VIBRATING FEEDER (IF APPLICABLE)

- i) The vibratory feeders shall be electromagnetic / electromechanical type. Each pyrite hopper shall be served by one vibratory feeder.
- ii) Vibrating feeder tray shall be provided with suitable liners.

5.03.03 METALLIC CONVEYORS

- i) Conveyors shall be designed for continuous removal of mill rejects. At least 25% margin on normal operating capacity shall be provided.
- ii) Metallic belt conveyor/Chain flight Conveyor will be required to handle highly abrasive rejects continuously. So all components shall be of proven design having a track record of trouble free-operation in order to avoid problems of frequent stoppages. The conveyor shall be sized for start up with load.
- iii) Casing of the conveyor shall be fully enclosed type and inspection doors shall be provided at every suitable point after reject discharge point.
- iv) Cross over shall be provided at every second discharge point suitably.
- v) The conveyor/rollers bearings shall be grease packed with facility of recharging from outside
- vi) Reliable and proven hydraulic/pneumatic auto take up arrangements, with facility of adjustment of tension. The tension assembly shall be designed to absorb any momentary shock loading.
- vii) 800 mm clear walkway on both sides of conveyor along with handrails shall be provided.
- viii) The conveyor shall be made up of Heat resistant stainless steel /alloy carbon steel / carbon steel, suitable for 200 deg C (minimum). Any other suitable material of construction of proven design is also acceptable.
- ix) Separate conveyor (if applicable) shall be provided to remove fines. The conveyor may operate continuously/intermittently.
- x) Suitable clean (if applicable) out conveyor shall be provided for removal of spillage/fines.

5.03.04 BUCKET ELEVATOR

- i) The Bucket Elevator shall be sized to handle the design capacity with the minimum material bulk density and a maximum bucket filling of 75% & maximum material size, for continuous twenty-four hour service in a heavy duty industrial application, handling abrasive materials in a dusty environment.
- ii) Casing of elevator shall be self supported and capable of supporting head shaft, drive, and service platform. Head section is to be split and equipped with handles or lifting lugs for easy removal. Access and inspection doors are to be provided.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- iii) Intermediate sections are to have a minimum plate thickness of 4 mm. Boot section to be fabricated of minimum 6mm steel plate, with front and rear access panels. A beam is to be provided in casing for servicing internal gravity take-up. The beam may be located either in the boot section or intermediate section as applicable.
- iv) Size, capacity and type of buckets and appropriate reinforcement necessary for the application shall be adequately sized. Pin holes shall be provided in bottom of buckets for air relief.
- v) Suitable heat resistant chain conveyor shall be provided
- vi) Bucket elevator drive should be sized for either 100% bucket filling at minimum material bulk density, or 75% bucket filling at maximum material bulk density, whichever is greater.
- vii) Inspection and Access Doors shall be loose-hinged type with quick-opening jamb bar fasteners and gaskets enclosed and retained in the door.
- viii) A dust collecting vent in the head section and boot section shall be furnished with drilled flanges.

5.03.05 MILL REJECT SILO

- i) The reject silo shall be fabricated out of minimum 12 mm thick steel plates with adequate stiffeners. The minimum valley angle of silo shall be 60deg. The inside surfaces shall be provided with removable 3 mm thick stainless steel SS 409 plate liners in conical portion.
- ii) The silo shall be sized at least to above mentioned capacities and shall be designed & located such that they can be emptied from bottom into Owner's trucks at regular intervals.
- iii) Access and platform shall be provided with 32 mm thick MS grating 32 NB GI pipe hand railing shall be provided wherever required. All handrail shall be florescent yellow color or florescent yellow strip
- iv) Pneumatically/electrically operated with provision of manual hand wheel undercut gate shall be provided at the mouth of each reject silo. Gate shall be double pivoted sector type. Suitable levers, pulleys /sheaves, ropes etc. shall be provided for operating the gate from the operating platform and ground level. The gear shall be made of cast steel and suitably hardened. The gate shall be designed for heavy duty application.
- v) Suitable vent with bag filters shall be provided at the top external to the silo. Vent filters shall have adequate number of bags made from synthetic fabric suitable for mill reject dust. Maximum air to cloth ratio (NM3/min/M2) shall be considered as 1.0 with isolation of 10% bags. The material of filter bags shall be suitable for prolonged operation up to a temp of 200°C without losing its collection efficiency and durability. Filter bags shall be suitably treated to minimize the chances of filter bags catching fire. It shall be possible to plug opening for the damaged bag filters, if any, to facilitate uninterrupted operation of the unit. The guaranteed particulate emission rate from the filter shall not be more than 27 mg/Nm³ of air. Suitable explosion vents shall be provided for the bag filter unit. Sequential cleaning cycle shall be initiated with pressure drop signal across the bag filter once sufficient cleaning air pressure is available. Solenoid/pneumatic valves shall be provided for this purpose.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

- vi) Bag cleaning mechanism shall be automatic, and shall comprise of solenoid valves, air nozzles, adjustable solid state timer, pressure switches, piping and fittings etc. Nozzles shall be placed just above the filter bags to facilitate individual cleaning of each bag.
- vii) The silo, supporting structures etc. shall be suitable for storing hot reject particles at 200°C.
- viii) Two (02) Nos. of level probes shall be provided in the silo to indicate 'silo full' and empty condition.
- ix) Silo discharge gate shall be operated remotely as well as manually

6.00.00 SPECIAL TOOLS & TACKLES AND TEST / MEASURING EQUIPMENTS

6.01.00 One complete set of all special tools and tackles for maintenance of all equipments for Steam Generator unit.

6.02.00 Special tools & tackles required for erection, testing and maintenance of mill equipment system including those required for instruments and controls

6.03.00 Each set of tools & tackles shall necessarily include but will not be limited to following:

- i) General Maintenance tools
 - a) Pulling cable, eyebolts, cable slings, chaining falls, snubbing lines or cables.
 - b) Bar and sledge hammers.
 - c) Brass and lead hammers.
 - d) Power type jacks and jacking screws.
 - e) Feeler gauges and shims.
 - f) Dial indicators.
 - g) Wire brushes & scrappers.
 - h) Bearing and coupling pullers.
 - i) Spanners and wrenches of various sizes.
- ii) Special Maintenance Tools for SG & its auxiliaries
 - a) Tube expanders for heat exchangers.
 - b) Lapping plates, grinding stones and ring cap for the valves.
 - c) The burner maintenance trolley with vice, burner.
 - d) Spanners and wrenches specific to the equipment.
 - e) Four (4) pneumatic emergency retract drives with matching crank tools for each type of soot boiler shall be provided along with required length of connecting pipe, fitting etc. Service air points for actuation of pneumatic drive shall be provided at convenient locations.
- i) Complete lifting tools and tackles. Bidder shall provide motorized hoists and trolleys for all items requiring maintenance and weighing 500 kg or more. All auxiliary structures, monorails, runway beams for all lifting tackles, hoists etc. are included in Bidder's scope of supply. Access ladders with suitable platform shall also be provided for approach to all motorized hoists/trolleys mounted on their runway beams for the maintenance of hoists/trolleys. Items weighing more than 50 kg and required to be replaced for



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

maintenance shall be provided with manual hoists/trolleys with runway beams/supporting structure etc.

- ii) One (1) set of quick erect scaffolding erectable inside of the Steam generator ensuring full height coverage for capital overhaul. The scaffolding system shall be made of light weight material and man days required for erection shall not exceed 4 (four) considering the workforce deployed for 24 hours in 3 shifts a day. The locking arrangement shall not call for any welding.
- iii) One (1) set of Igniter Testing kit shall be provided for the purpose of testing healthiness of (a) solenoid valve, power cylinder, limit switches of the ignitor carriage assembly (b) ignitor cable, rod and spark tip of the sparking system. This shall include stand for holding / fixing the igniter carriage assembly, LED for ignitor advance/retract feedback, necessary air line accessories for solenoid/power cylinder operation, Push button for advance/spark command, etc. Required power supply point and instrument air connection point shall be provided by the customer. Installation and commissioning of the Testing kit shall be in the bidder's scope.
- iv) Scope shall include instrument for tube thickness measurement and other metallurgical aspects as follows: (All instruments shall be of latest version considering order awarding date and portable/easy to move)
 - a) The scope shall include 03 ultrasonic thickness gauges (D-meters) (Olympus or equivalent brand) suitable for measurement of the pressure part tube/pipe thickness. The above ultrasonic thickness gauge(s) shall also have a built in data logger to facilitate quick/automatic transfer of the measured data. The data logger shall have adequate memory and shall be programmable to configure the tube location geometry as required for automatic down loading to compatible PC based software like Boiler Maintenance Work Station (BMW) of EPRI (USA) or equivalent.
 - b) One (1) videoscope suitable for inspection of all steam generator pressure parts. This shall be of the flexible optical fibre pattern appropriate to the design of the headers and shall incorporate low voltage lighting via either a portable transformer or rechargeable battery. A rigid type is not acceptable. It is envisaged that the instrument may be made in section to give adequate variations in reach to suit different headers. The viewing head must permit a vision of 90 deg., forward and/or rear by interchangeable heads. The degree of magnification desired is 1:1 at a distance of about 70mm to 100mm with a maximum of 3:1 for very close viewing.(Minimum length of optical fibre cable shall be 3 mtrs)
 - c) UCI based hardness tester - 02 unit
 - d) PMI machine for material checking - 02 units (Olympus or equivalent brand)
 - e) Induction preheater with an air-cooled system of adequate capacity for temperatures up to 1450° F for PWHT. The preheater features multiple (at least 6) outputs, six control thermocouples to ensure uniform heating, significantly faster time to temperature than conventional heating, and an extremely easy-to-use operator interface that allows the operator to program ramp and hold temperature



GUJARAT STATE ELECTRICITY COPRORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

times. For the suitable pipe size with Diameter of 25 to 600mm and Thickness of 25-120mm. Accessories: Digital Controller & Recorder, Ceramic Pad heaters, Splitter cables, etc.

- v) One (1) coal abrasion test apparatus along with all necessary accessories for steam generators for testing YGP index of coal, complying with the requirements of BS 1016 Part 111. The apparatus shall be complete with following basic components and accessories:
- Mill pot or mortar
 - Drive Unit
 - Four blades (in addition to the blades fixed in the apparatus for abrasion testing, a set of four blades shall be supplied extra as spare).
 - Gauges for checking gap between the edges of the blades and the internal wall and bottom of the mill pot.
 - Heavy duty balance
 - Analytical balance
 - Jaw crusher (hand fed, electrically operated)
 - Mechanical sample divider.
 - Test sieves of woven wire cloth with nominal aperture size 6.70 mm and 16.0 mm and of perforated plate, square hole, with nominal aperture size 25.0 mm, complying with BS 410.
 - Hot air dryer.
 - Small brass brush.
 - Any other item to make the test set up complete.
- vi) Bomb calorimeter, Oven, Furnace etc instruments/equipments required for analysis of Oil & Coal.

7.00.00 DATA SHEETS – A

7.01.00 Steam Generator

Sl. No.	Item	Unit	Description
7.01.01	Type of Steam generator	-	Once through reheat, radiant, dry bottom, balanced draft, outdoor
7.01.02	Fuel	-	
i)	-for load carrying	-	Coal
ii)	-during integration to renewable energy resources (maximum 10 hours a day)	-	Coal (Boiler load ~30% BMCR equivalent to 35% TMCR)
iii)	-for flame stabilisation		Light Diesel Oil (LDO)



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
iv)	-for start-up / warm-up		Light Diesel Oil (LDO)
7.01.03	Capacity at BMCR (Steam flow at SH outlet)		Maximum of (a) 102% of Steam required for the turbine VWO capacity and (b) 2425 TPH.
7.01.04	Steam pressure at SH outlet at BMCR		270~276 bar(a) i.e. 103.5% to 104.5% of steam pressure at ESV inlet.
7.01.05	Steam temperature at SH outlet at BMCR	°C	603
7.01.06	Steam temperature at RH outlet at BMCR	°C	613
7.01.07	Maximum Avg. Flue gas velocity in SH/RH section/tube bank, with transverse tube pitching 600 mm or less and with 20% excess air at economiser outlet		9m/s. (the maximum localised velocities across the cross section shall not exceed 10m/s.)
7.01.08	Maximum allowable tube metal skin temperature		40 °C below oxidation limit for the tube metal.
7.01.09	SH/RH outlet steam temperature characteristic below control range		- As close as possible to each other - Minimum drop from rated steam temperature
7.01.10	Means of temperature control		
i)	Super heaters		Spray water attemperation (utilising water tapped of from downstream side of last /top HP heaters)
ii)	Re heaters		Tilting of burners / gas biasing / gas recirculation (gas to be tapped off after ID fans), spray water attemperation (utilising water tapped off from inter-stage of BFP)
7.01.11	Exit flue gas temperature at RAPH outlet (considering leakage in RAPH)	°C	125
7.01.12	Explosion force / Implosion		Maximum of + 660 mm WC at 67% yield strength or maximum conceivable Shut off head of the ID/FD fan at Test Block condition



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
			and ambient temperature
7.01.13	Operation		i) Base Load and Sliding Pressure ii) Extended operation (~10 hours) at lowest technically minimum load without oil firing for renewable integration.
7.01.14	Code		IBR AND ASME or other reputed international codes
7.01.15	FURNACE - Bidder shall consider the following design indices while designing the furnace:		
i)	Maximum net heat input (NHI) per unit plan area	kCal/hr/ m ²	4.75×10^6 (5.5243 MW/m ²)
ii)	Burner zone heat release rate (BZHRR)	kCal/hr/ m ²	1.36×10^6 (1.582 MW/m ²)
iii)	Heat input per effective projected radiation surface (EPRS)	kCal/hr/ m ²	2.0×10^5 (0.2326 MW/m ²)
7.01.16	Maximum furnace exit gas temperature (FEGT) – at vertical plane parallel to arch/goose neck		60°C below initial deformation temperature (IDT) of ash or 1040 deg.C whichever is lower.
7.01.17	Pressure withstanding capability	mmwc	Minimum ± 660 mmWc at 67% yield strength or maximum conceivable head of fans, whichever is higher as per latest NFPA standards
7.01.18	Un-burnt combustibles in flue gas	%	≤ 1.5 of fly ash at economiser outlet and $\leq 0.25\%$ bottom ash
7.01.19	Excess air at RAPH inlet	%	20% max
7.01.20	Ambient temp. for performance test	°C	31°C with 66% of relative humidity.
7.01.21	Furnace tube arrangement		Membrane wall construction
7.01.22	Type of furnace tubes and header for pressure parts		Seamless spiral plus vertical, or vertical rifle tubes



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.01.23	Flue gas velocity in Boiler convection/ second pass	m/s	<9
7.01.24	Boiler circulation pumps		1X100%
7.01.25	MATERIALS OF CONSTRUCTION		
	MoC for Steam Generator pressure parts/ Piping and other components		
	Design Metal Temperature (T)		Material
i)	Up to & including 426°C		ASME SA 106 Gr. B/C or SA 210 Gr. C, SA 178, SA 192 or approved equivalent.
ii)	$426 < T \leq 485$		ASME SA 335: P-1A/P-11 / P-12 / P-22 ASME SA 213: T-1A/ T-11 / T-12 / T-22 / T-23
iii)	$485 < T \leq 535$		ASME SA 335: P-11/P-22/P-91 ASME SA 213: T-11/T-22/T-91 P/T-91 is preferred at T> 500 deg.C.
iv)	$535 < T \leq 580$		ASME SA 335: P-22/P-91 ASME SA 213: T-22/T-91/TP-304 Or approved equivalent. P/T-91 are preferred.
v)	$580 < T \leq 620$		SA 335 P-91/P-92 SA 213 T-23/T-91/T-92/TP-304H/ S30432 shot peened/TP347H Or approved equivalent.
vi)	$620 < T \leq 650$		SA 335 P-92/P-122 SA 213 T-92/T-122/TP-321H/TP-347H
vii)	$650 < T \leq 730$		SA 213 TP347HFG/ TP-310CbN
7.01.26	Inspection /Access doors		Heat resistant without water cooling
7.01.27	Buckstay spacing and support		Spacing shall be such that the natural frequency of buckstay shall be sufficiently away from flame



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
			pulsation frequency. Support shall be self support from boiler walls without any connection with boiler structure.
7.01.28	Economiser tube thickness		Provide erosion allowance of 1.6 mm (minimum) in addition to thickness calculated as per IBR formulae
7.01.29	Evaporator		Provide erosion allowance of 1.6 mm (minimum) in addition to thickness calculated as per IBR formulae
7.01.30	Superheater / Reheater		Provide erosion allowance of 1.6 mm (minimum) in addition to thickness calculated as per IBR formulae
7.01.31	Economisers		
i)	Type		Non-steaming type with parallel cross flow or counter flow arrangement.
ii)	Approach temperature within control rage		17 °C (minimum)
iii)	Flue gas velocity at entry to top/last bank of Economiser with 20% excess air at economiser outlet		10 m/s. at BMCR condition
iv)	Economiser tube thickness		Provide erosion allowance of 1.6mm (minimum) in addition to thickness calculated as per IBR formulae.
v)	Maximum allowable tube metal skin temperature		40 °C below oxidation limit for the tube metal.
vi)	Maximum depth of tube banks/sections in the direction of gas flow		Two (2) m or maximum soot blowing radius, whichever is lower.
7.01.32	Furnace Bottom Hopper		Design of Boiler and its supporting structure shall be considering 50% ash/clinker loading in furnace bottom hopper and corresponding to ash density of 1600Kg/m ³ . Further minimum sixteen (16) Nos.



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
			of load cells shall be installed by Bidder in the furnace roof enclosure to give indication of ash build up in the furnace bottom hopper. The Bidder shall provide the design basis for the selection for number of load cells, their distribution and fixing up of alarm set points.

NOTE: The bidder to decide based on throttle steam pressure at turbine inlet and pressure drops in MS piping and fittings. Similarly, the SH and RH outlet temperatures shall be based on temperature drops in MS line and RH line, respectively.

1. Superheater(s) and Reheater(s) shall be designed, suitably sectionalized and positioned to comply with the above, for the specified load(s), coal(s) and for normal, upset, most adverse and other operating conditions as specified and anticipated.
2. The control system for SG shall be able to maintain SH/RH outlet temperatures within $\pm 5^{\circ}\text{C}$ of above values over complete control range of Steam Generators with the range of specified coals.
3. In case gas recirculation system is offered for reheat temperature control, minimum 2x100% gas recirculation fans with atleast 20% margin on flow and 44% margin on head over calculated maximum requirement of fan flow and head respectively shall be provided.
4. Furnace exit gas temperature is the temperature of flue gas at furnace outlet plane parallel to arch/ goose neck. Bidder shall furnish a sketch of the furnace indicating the furnace outlet plane, with relevant dimensions of the furnace.
5. In case the excess air value is less than 20%, bidder shall substantiate the same by furnishing reference of minimum of two plants of 660 MW and above and of similar design operating at least for one year.

7.02.00 Steam Separator(s)

Sl. No.	Item	Unit	Description
7.02.01	Design Code		IBR
7.02.02	Design Temperature	$^{\circ}\text{C}$	Minimum 40°C , over & above Maximum fluid temperature
7.02.03	Design pressure		Min. 1.05 times the max. Operating pressure or as required by IBR/ASME, whichever is higher.



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

7.03.00 Regenerative Air Preheaters

Sl. No.	Item	Unit	Description
7.03.01	Type		Trisector (2 X 60%)
7.03.02	On load cleaning medium		Steam
7.03.03	Off load cleaning medium		Water
7.03.04	Air preheater leakage		Shall not exceed 5% of total air requirement.
7.03.05	Accessories to be provided		
i)	Auxiliary air motor required		Yes
ii)	Hand operated barring device required		Yes
iii)	Seal plate adjustment		Automatic and external
iv)	Air receiver		Adequate for safe coasting down without external air supply
v)	Fire fighting system to be provided?		Yes
vi)	Air supply to air receiver		From station service air system
7.03.06	MATERIALS OF CONSTRUCTION		
i)	Hot end elements		Carbon steel or equivalent
ii)	Cold end elements		Corten steel or equivalent
iii)	Rotor and intermediate section elements		Corrosion resistant low alloy steel
iv)	Minimum flue gas temperature at all loads		Minimum 10°C above acid dew point of flue gas.
v)	Design ambient temperature and RH		31 deg.C and 66%
7.03.07	Sector Angles		



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
i)	Primary Air (PA) sector		72 deg.
ii)	Secondary Air (SA) sector		108 deg.
iii)	Flue Gas (FG) sector		180 deg.

7.04.00 Fans -Combined ID

Sl. No.	Item	Unit	Description
7.04.01	GENERAL		
i)	Designation		Induced draft fan (ID fan)
ii)	Number		Two(2) nos. per boiler/unit
iii)	Type		Two stage, Constant speed, Axial type
7.04.02	Fan sizing with all following conditions occurring together		Each fan to be sized for 60% BMCR load (one stream in operation) calculated taking into account this.
i)	Type of coal firing		Design / best / worst, whichever gives maximum flue gas flow
ii)	Power supply frequency	Hz	50
iii)	Fan inlet flue gas temperature		Gas temperature corresponding to 50°C ambient temperature and 60% relative humidity
iv)	Pressure required at Chimney		30% over 100% BMCR requirements Pressure at chimney inlet shall be +25mmwc.
v)	Pressure drop through SCR system		100 mm WC or actual, whichever is higher
vi)	Pressure drop through ESP		25 mm WC or actual, whichever is higher
vii)	Pressure drop through FGD system		150mm WC or actual, whichever is higher;



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
viii)	Flue gas temperature for FGD plant design	Deg.C	140 (Short-term peak of 300 deg.C)
ix)	Excess air		20% over the stoichiometric air requirement
x)	Air-heater air-in-leakage		Based on Min. 10 % of gas flow entering PAPH, and min. 5% of gas flow entering SAPH, in case of bi-sector APH (or) 8% of flue gas flow entering tri-sector APH; or actual guaranteed whichever is higher
xi)	Air in leakage		1% of ESP inlet gas flow & 2% of gas flow at common APH outlet through ducts.
7.04.03	The fans shall also fulfil following sizing criteria in addition to those mentioned above		Each fan shall also be sized for 60%BMCR flow calculated taking into following conditions occurring together
i)	Type of coal firing		Design / best / worst, whichever gives maximum flue gas flow
ii)	Margin over 100% BMCR flow		20%
iii)	Margin over 100% BMCR pressure requirement		44%
iv)	Excess air		20% over the stoichiometric air requirement
v)	Power supply frequency	Hz	50
vi)	Fan inlet flue gas temperature (Test Block)		150°C or actual Gas temperature corresponding to 50°C ambient temperature and 60% relative humidity; whichever is higher.
vii)	Air heater air in leakage		Based on Min. 10 % of gas flow entering PAPH, and min. 5% of gas flow entering SAPH, in case of bi-sector APH (or) 8% of flue gas flow entering tri-sector APH; or actual guaranteed whichever is higher
viii)	Air in leakage		1% of ESP inlet gas flow & 2% of gas flow at common APH outlet through ducts.
ix)	Pressure drop through SCR		100mmWC, or actual, whichever is higher



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
x)	Pressure drop through ESP		25mmWC, or actual, whichever is higher
xi)	Pressure drop through FGD system		150mm WC or actual, whichever is higher;
7.04.04	Speed	rpm	
i)	First critical speed	rpm	At least 15% above normal speed
7.04.05	Blade type		Backward curved, aerofoil type
7.04.06	Flow control		Blade pitch control
7.04.07	Fan / motor bearings		Self aligning
7.04.08	Minimum stall margin		10% over design duty points
7.04.09	Motor rating		MCR rating corresponding to maximum cooling water temperature to cooler inlet or motor rating at 50°C ambient temperature (as applicable), not less than the maximum load demand in its entire range of operation, at frequency variations from 47.5 to 51.5 HZ and motor not to be overloaded during any mode of operation.
7.04.10	Material Of Construction		
i)	Fan scroll		Lined with abrasion resistant material
ii)	Suction chamber		IS 1079 / 73 SH. 34
iii)	Casing		IS 2062
iv)	Shaft		SAE 1045 forged normalised and tempered steel
v)	Sleeves		High grade Babbitt



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
vi)	Regulating vane		IS 1079 / 73
vii)	Diffusers and dampers		IS 2062
viii)	Bearing housing		Grey cast iron
ix)	Coupling		Flexible

7.05.00 Fans - FD

Sl. No.	Item	Unit	Description
7.05.01	GENERAL		
i)	Designation		Forced draft fan (FD fan)
ii)	Number		Two (2) nos. per boiler/unit
iii)	Type		Constant speed, Axial type
7.05.02	Fan sizing with all following conditions occurring together		Each fan to be sized for 60% BMCR load (one stream in operation) calculated taking into account this.
i)	Type of coal firing		Design / best / worst, whichever gives maximum FD fan air flow requirement
ii)	Power supply frequency	Hz	50
iii)	Fan inlet air temperature		50°C ambient temperature and 60% relative humidity
iv)			
v)	Excess air		20% over the stoichiometric air requirement
vi)	Air-heater air-in-leakage		Secondary air-in-leakage of Min. 10% of flue gas flow entering bi-sector APH, or actual guaranteed whichever is higher For tri-sector APH actual



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
			guaranteed value of leakage shall be considered for fan sizing.
7.05.03	The fans shall also fulfil following sizing criteria in addition to those mentioned above		Each fan shall also be sized for 60% BMCR flow calculated taking into following conditions occurring together
i)	Type of coal firing		Design / best / worst, whichever gives maximum flue gas flow
ii)	Margin over 100% BMCR flow		20%
iii)	Margin over 100% BMCR pressure requirement		44%
iv)	Excess air		20% over the stoichiometric air requirement
v)	Power supply frequency	Hz	50
vi)	Fan inlet air temperature		5°C above maximum ambient temperature or 50°C ambient temperature and 60% relative humidity.
vii)	Air heater air in leakage		Secondary air-in-leakage of Min. 10% of flue gas flow entering bi-sector APH, or actual guaranteed whichever is higher For tri-sector APH actual guaranteed value of leakage shall be considered for fan sizing.
7.05.04	Speed	rpm	
i)	First critical speed	rpm	At least 15% above normal speed
7.05.05	Blade type		Backward curved, aerofoil type
7.05.06	Flow control		Blade pitch control
7.05.07	Fan / motor bearings		Self aligning
7.05.08	Minimum stall margin		10% over design duty points



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.05.09	Motor rating		MCR rating corresponding to maximum cooling water temperature to cooler inlet or motor rating at 50°C ambient temperature (as applicable), not less than the maximum load demand in its entire range of operation, at frequency variations from 47.5 to 51.5 HZ and motor not to be overloaded during any mode of operation.
7.05.10	Material Of Construction		
i)	Fan scroll		Lined with abrasion resistant material
ii)	Suction chamber		IS 1079 / 73 SH. 34
iii)	Casing		IS 2062
iv)	Shaft		SAE 1045 forged normalised and tempered steel
v)	Sleeves		High grade Babbitt
vi)	Regulating vane		IS 1079 / 73
vii)	Diffusers and dampers		IS 2062
viii)	Bearing housing		Grey cast iron
ix)	Coupling		Flexible

7.06.00 Fans -PA

Sl. No.	Item	Unit	Description
7.06.01	Designation		PA fan
7.06.02	Number		Two (2) x 60% for each type corresponding to BMCR requirement



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.06.03	Location		Outdoor
7.06.04	Type		Two stage, constant speed, variable pitch, axial type.
7.06.05	Design parameters		
i)	Fan sizing with all following conditions occurring together		Each fan to be sized for 60% BMCR load (one stream in operation) calculated taking into account this.
ii)	Type of coal firing		Worst coal with maximum moisture content
iii)	Power supply frequency	Hz	50
iv)	Head		30% over 100% BMCR requirement.
v)	Ambient air-Temperature		5°C above maximum ambient temperature or 50 °C & RH 66%; whichever is higher.
vi)	Air-heater air-in-leakage		Primary air-in-leakage of Min. 10% of flue gas flow entering bi-sector APH, or 5% air-in-leakage of 8% of flue gas flow entering in case of a tri-sector APH or actual guaranteed whichever is higher
vii)	The fans shall also fulfil following sizing criteria in addition to those mentioned above		In any case the margins on flow & pressure shall not be less than 25% and 30% respectively, over the calculated values at 100% BMCR condition; under following conditions occurring together
viii)	Type of coal firing		Worst coal with maximum moisture content
ix)	Power supply frequency	Hz	50
x)	Ambient air-Temperature		5°C above maximum ambient temperature or 50 °C & RH 60%; whichever is higher.
xi)	Air-heater air-in-leakage		Primary air-in-leakage of Min. 10% of flue gas flow entering bi-sector APH, or 8% air-in-leakage of flue gas flow entering in case of a tri-



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
			sector APH or actual guaranteed whichever is higher
xii)	Mill in service		All mills including standby mills.
7.06.06	Speed	RPM	1500 (Max)
i)	First critical speed		At least 15% above normal speed
ii)	Flow control		Variable Pitch Control
7.06.07	Fan / motor bearings		Self aligning
7.06.08	Minimum stall margin		10% over design duty points
7.06.09	Motor rating		Motor rating at 50°C ambient temperature not less than the maximum load demand, in its entire range of operation at frequency levels from 47.5 to 51.5 Hz and motor not to be overloaded during any mode of operation.
7.06.10	MATERIALS OF CONSTRUCTION		
i)	Impeller blade		High Strength aluminium alloy (RR 50) or Equivalent
ii)	Impeller hub		Forged steel or fabricated steel
iii)	Shaft		SAE 1045 or equivalent forged normalized and tempered steel

7.07.00 Seal Air Fans

Sl. No.	Item	Unit	Description
7.07.01	Designation		Seal Air fan
7.07.02	Number		Two (2) x 100% common for all the mills
7.07.03	Type of fan		Centrifugal



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.07.04	Margin		
i)	On Flow		25%
ii)	On pressure		30%
			Above margins shall be based on an ambient temperature of 50°C, relative humidity of 60% and system leakages with mill operation at maximum duty.
7.07.05	Fan rotational speed	Rpm	1500 (max) under test block condition
7.07.06	Motor rating		Motor rating at 50°C ambient temperature not less than the maximum load demand, in its entire range of operation at frequency levels from 47.5 to 51.5 Hz and motor not to be overloaded during any mode of operation.

7.08.00 Soot Blowing System

Sl. No.	Item	Unit	Description
7.08.01	Type		Selective operating type control based change in heat flux on the water walls
7.08.02	Designation		Wall blowers, Rotary blowers, long retractable blowers, short retractable blowers and air preheater blowers.
7.08.03	Cleaning medium		Superheated /Reheater steam
7.08.04	Drive		Dual electric drive for traverse and rotary motion
7.08.05	Location		Out door
7.08.06	Accessories Required		
i)	Emergency hand crank for every soot blower		Yes



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
ii)	Facility to adjust angular travel of short retractable soot blower		Yes
7.08.07	MATERIALS OF CONSTRUCTION		
i)	Lance / swivel tube - in high temp. area		High temp. chrome steel
a)	- in intermediate temp area		Steel with chromium surface coating
b)	- in low temp. area		Carbon steel
ii)	Nozzle		18% chromium, 12% Ni stainless steel
iii)	Bearing (in high temp. area)		Chrome alloy steel
iv)	Bearing (in intermediate temp. area)		Chrome cast iron Alloy
v)	Bearing (in low temp. area)		Cast Iron or Steel
vi)	Blowing head		Stainless steel 304
vii)	Feed Tube		Stainless steel 304

7.09.00 Coal Burners

Sl. No.	Item	Unit	Description
7.09.01	GENERAL		Proven make, Low NOx burners. To cater to 100% BMCR load stable operation,
7.09.02	Combustion air		Secondary / primary
7.09.03	DESIGN DATA		
i)	Turn down ratio		3:1 / To match with coal mills
ii)	Coal fineness		75% through 200 mesh & 99% through 50 mesh



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
iii)	Excess air		20% at APH inlet
iv)	Mode of adjustment of combustion air		Air damper
v)	NOx limit		Total NOx emission including fuel NOx and thermal NOx shall not exceed 260 grams per giga joule heat input to boiler or 450 mg/Nm ³ whichever is lower.
7.09.04	MATERIALS OF CONSTRUCTION		
i)	Coal burner nozzle		High chrome heat resistant
ii)	Guide plates		High chrome heat resistant
iii)	Minimum guaranteed life wear parts		8400Hrs (minimum)

7.10.00 Coal Mills

Sl. No.	Item	Unit	Description
7.10.01	Coal mills Maximum permissible mill loading Mill inerting / fire fighting system		Medium speed vertical spindle; Coal Mill combination shall be (N+1) where, N Nos. will be working and 1 will be standby at BMCR worst coal firing. Mill loading shall be limited to 90%, Proven inerting / fire fighting system shall be provided along with detection system as per NFPA guidelines.
7.10.02	Maximum permissible mill loading for deciding mill capacity		90% of the mill loading achievable corresponding to the near worn out conditions of mill grinding elements, whichever is less. This condition shall be complied for the range of coal including the adequacy range of coals.
7.10.03	Vertical spindle types		Bowl



GUJARAT STATE ELECTRICITY COPRORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.10.04	Differential pressure across mill bowl		425mm WC (approx)
7.10.05	Mill Reject		Maximum 1.5% (For Worst Coal)
7.10.06	Output fineness at rated capacity, not less than		75% through 200 mesh (75 microns)&99% through 50 mesh (300 microns) To be demonstrated at site for each mill by coal sampling as per ISO 9931 & with grinding elements within the guaranteed wear life of respective wear elements.
7.10.07	Minimum stable load without oil support		30% of BMCR
7.10.08	Coal sampling device for sampling coal from coal mill discharge with rigid accessible platform.		Required as per ISO / ASME. One working and one as standby.
7.10.09	Sampling connection & cock on coal pipe to each burner		Required
7.10.10	MATERIALS OF CONSTRUCTION		
i)	Lube oil system		Integral
ii)	Grinding ring/race		Segmental
iii)	Shaft		Coupled / Mono block / Mfg. Std.
iv)	Coupling		Flexible gear
v)	Drive transmission		Gear
vi)	Minimum mill wear parts life	Hrs	8000Hrs for grinding elements, 20000Hrs for seals, 25000 Hrs for other Wear parts like bull ring segments, classifier, coal pipes etc.
7.10.11	Input coal size to pulveriser	mm	(-50mm)



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.10.12	Noise Level	dBA	Should not exceed 90 dBA

7.11.00 Coal Feeder and Coal Pipes

Sl. No.	Item	Unit	Description
7.11.01	Type		Rotary Gravimetric (Drum Type).
7.11.02	Number required		One for each mill.
7.11.03	Coal feeder control		tacho generator
7.11.04	Feeder capacity		Minimum 20% spare capacity over maximum mill capacity.
7.11.05	Coupling Guards		Yes
7.11.06	Paddle type switch to detect the presence of coal		Yes
7.11.07	Environment withstand capability		Ambient temperature 70°C (min.) Explosion pressure – 3.5 kg/cm ² (min.) Other anticipated environment conditions
7.11.08	Feeder Accuracy		
i)	Weighing accuracy at works		±0.5%
ii)	Repeatability		0.1%
iii)	In-built facility for calibration		Yes
iv)	Sealing system for coal feeder		Yes
7.11.09	COAL PIPES		
i)	Thickness of straight coal pipe base material	mm	Wear resistant, weld-able steel and of minimum thickness not less than 12 mm on straight length



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
ii)	Thickness of coal pipe bend base material	mm	20 mm (but not less than one and a halftimes the straight pipe thickness) at outer radius of bends
iii)	Coal pipe lining thickness	mm	15 (Minimum liner thickness to cover the specified minimum guaranteed life)
iv)	Fuel air mixture velocity in coal pipe	m/s	Minimum – 15m/s Maximum – 28m/s
v)	Maximum permissible design stress		Yield, or 0.2% proof stress
vi)	Hot air jacketing on feed pipe from feeder to mill		Required if recommended by bidder.
vii)	Sealing system for coal feeder		Required
viii)	Design (Explosion) pressure	kg/cm ²	3.5 (minimum) as per NFPA requirement
ix)	Continuous operating temperature	°C	110°C (min.)
x)	Guaranteed liner life	hrs	25000 (Minimum)

The coal air mixture velocity in the coal pipes shall not be lower than the critical fallout velocity, under all conditions of mill operation from start-up of boiler onwards

7.12.00 Fuel Oil Burner (LDO) and Igniters

Sl. No.	Item	Unit	Description
7.12.01	Design Capacity		Start up / low load flame stabilisation with centralised automatic control with flame scanner and safety protection. LDO –30% of BMCR load
7.12.02	Fuel oil		Light diesel oil for start-up and flame stabilisation.
7.12.03	No. of independent oil firing streams		1 (catering to requirements of boilers)
7.12.04	Turndown ratio of fuel oil burners		3 : 1



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.12.05	Type of oil Igniters		High Energy Arc (HEA), Air atomised type
7.12.06	Atomising medium		Compressed Air for LDO
7.12.07	Burner cooling medium		Air
7.12.08	Burner tip material		Resistant to corrosion due to fuel oils containing sodium, vanadium, sulphur, chloride etc.
7.12.09	Hardness of atomiser (to be retained even at 400°C)		Vickers Hardness number of 400 (min.)
7.12.10	Life of burner tips, before maintenance/replacement	Hrs.	16000 (min.)
7.12.11	MATERIALS OF CONSTRUCTION		
i)	Oil burner – spray plate mixing plate		Alloy steel
ii)	Diffuser		Alloy steel
iii)	Nozzle cap		Alloy steel

Note: To arrive at 30% BMCR requirements for sizing of LDO/HSD system, value corresponding to 30% of 100% fired at BMCR; worst coal to be considered.

7.13.00 LDO Pumps

Sl. No.	Item	Unit	Description
7.13.01	Designation		LDO Transfer Pump LDO Pressurisation Pump
7.13.02	Number required		2x100%(LDO) Transfer Pumps pumping oil from existing oil tank /unloading header to Storage cum 3x 50%(LDO) Pressurisation Pumps pumping oil from Storage cum Day oil Tank to boiler front



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description	
			Day oil Tank.	
7.13.03	Type of bearing		Antifriction heavy duty and external	Antifriction heavy duty and external
7.13.04	Design motor size of the pumps		Based on highest viscosity of oil plus 15% as margin	Based on highest viscosity of oil plus 15% as margin
i)	Design capacity of the pumps		Based on lowest viscosity of oil plus 10% margin	
ii)	Capacity		Bidder to indicate suitably to ensure stable firing at burner station at all operating load range of oil burners.	
iii)	Discharge Pressure		Bidder to indicate suitably to ensure stable firing at burner station at all operating load range of oil burners.	
7.13.05	LIQUID DATA			
i)	Liquid pumped		LDO	LDO
7.13.06	MATERIALS OF CONSTRUCTION			
i)	Casing		Fabricated steel	
ii)	Rotor		BS 970 EN 9 or equivalent	
iii)	Shaft		BS 970 EN 9 or equivalent	
iv)	Base plate		Fabricated Steel / CI	



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

7.14.00 Strainers

Sl. No.	Item	Unit	Description
7.14.01	Fluid / Application		Lube Fuel oil / Lube oil
7.14.02	Quantity Required		As per approved design
7.14.03	Location		As per approved design
7.14.04	Type		Duplex
7.14.05	Flow rate, kg/hr		As per approved design
7.14.06	Operating pressure – Kg/cm ² (g)		As per approved design
7.14.07	Operating temperature – °C		As per approved design
7.14.08	Design pressure – Kg/cm ² (g)		As per approved design
7.14.09	Design temperature – °C		As per approved design
7.14.10	Fluid viscosity cP at Op. temp		As per approved design
7.14.11	Fluid Sp. gravity at Op. temp.		As per approved design
7.14.12	Max. permissible Pr. Drop at 50% clogging		As per approved design
7.14.13	Screen / basket data		
i)	CA of perforations		As per approved design
ii)	Min. Thickness – mm		1.5
iii)	Free straining area		4 times pipe cross sectional area.
7.14.14	Steam jacket		No
i)	(a) Inlet pr. Kg/cm ² (g) Op. / Desn.		-



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
ii)	(b) Inlet temp. °C Op. / Desn.	-	
7.14.15	End connections		
i)	Size NB mm		As per approved design
ii)	Type		Welded
iii)	Details / Standards		ANSI B 16.25
7.14.16	Cover		Quick opng./ Bolted
i)	Body		Cast carbon steel ASTM A 216 Gr. B
ii)	Cover		- do -
iii)	Screen basket		Stainless steel
iv)	Bolts / Studs		ASTM A 193 Gr. B7
v)	Nuts		ASTM A 194 Gr 2H
vi)	Gaskets		Red rubber – Full face wire inserted
7.14.17	Vacuum test required		No
7.14.18	Press. drop test required clean/50% clogged		Yes

7.15.00 Dampers

Sl. No.	Item	Unit	Description
7.15.01	Numbers		As per functional requirement
7.15.02	Application		Isolation / Control, pneumatic actuator control for control dampers and fast acting pneumatic/electric actuator



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
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MRHS

REV. - 0

Sl. No.	Item	Unit	Description
			control for isolation dampers
7.15.03	Duty		Intermittent / Continuous
7.15.04	Installation		Outdoor
7.15.05	Gas handled		Flue gas / cold air / hot air mixed with particulate matter
7.15.06	DESIGN AND CONSTRUCTION REQUIREMENT		
i)	Isolation damper		Zero leakage guillotine type -ESP inlet and outlet -ID fan inlet and outlet -GR fan inlet and outlet (if applicable) -Air pre heater inlet and outlet (flue gas side) Outlet of each FD fan (double louver type) Outlet of each PA fan
ii)	Blade shaft		Horizontal with adjustable collar
iii)	Pressure seal packing gland		On each shaft end
iv)	Bearings		Grease lubricated anti friction type
v)	Drive type		Electric
7.15.07	MATERIALS OF CONSTRUCTION		
i)	Dampers frame		Heavy structural steel channels or plates not less than 10 mm thick
ii)	Blades		Not less than 10 mm thick made up of 2 x 5 mm thick plates
iii)	Linkage bolts and pins		Stainless steel



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

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TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
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MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.15.08	Ducts Flue gas side		To be designed for 13m/s flue gas velocity before ESP and 15m/s flue gas velocity after ESP
i)	Air side		. Designed for 16m/s velocity
ii)	Design pressure		+ 660mmwc at 67% of yield strength or maximum conceivable pressure.
iii)	Thickness		Minimum thickness of 8mm for flue gas ducts and 6mm for air ducts
iv)	Air Velocity		
a)	Cold Air	m/s	Maximum 16m/s
b)	Hot Air	m/s	Maximum 20 m/s

7.16.00 Flash Tank

Sl. No.	Item	Unit	Description
7.16.01	Number		As per requirement
7.16.02	Location		Atmospheric flash tanks- Outdoor, Other flash tanks – indoor.
7.16.03	DESIGN DATA		
i)	Operating pressure	Kg/cm ² (a)	Bidder to indicate
ii)	Design pressure	Kg/cm ² (a)	*
iii)	Operating temperature	°C	*
iv)	Design temperature	°C	*
v)	Corrosion allowances	mm	3 (min.) ---



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
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MRHS

REV. - 0

Sl. No.	Item	Unit	Description
vi)	Spray arrangement		As per requirement
7.16.04	MATERI ALS OF CONSTRUCTION		
i)	Shell and head		---Carbon steel---
ii)	Internal piping		---ASTM-A106-Gr.B--
iii)	Nozzle		---ASTM-A106-Gr.B--

7.17.00 Steam Air Coil Preheater

Sl. No.	Item	Unit	Description
7.17.01	Number of heaters		2 X 50%
7.17.02	Location		Outdoor, in FD fan discharge bypass duct.
7.17.03	Mounting		Horizontal
7.17.04	Number for each FD/PA fan discharge duct		One
7.17.05	DESIGN DATA		
i)	Shell side		FD Fan discharge air in trisector type or PA&FD fan discharge air in bisector type
ii)	Tube side fluid		Steam
iii)	Quality of steam		Superheated
iv)	Air temperature at the inlet		To keep average cold end metal temperature minimum 10°C above the acid dew temperature of flue gas.
v)	Design ambient air temperature		10°C



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

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BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
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MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.17.06	Materials of Construction		
i)	Tubes		90/10 Cu.Ni
ii)	Fins		Copper

7.18.00 Piping and Valves

Sl. No.	Service	Size	Pipes	Fittings	Flange	Gaskets	Line Joint
7.18.01	Steam Temp. 550°C and Above upto 600°C	NB 65MM & Above	ASTM A335 - P91	ASTM A234 - WP91	ASTM A182 - F91	Spiral Wound SS 316	Butt Welded
i)		NB 50MM & Below	ASTM A335 - P91	ASTM A182 - F91	ASTM A182 - F91	Spiral Wound SS 316	Socket Welded
7.18.02	Steam Temp. Above 510°C and Upto 549°C	NB 65MM & Above	ASTM A335 - P22	ASTM A234 - WP22	ASTM A182 - F22	Spiral Wound SS 316	Butt Welded
i)		NB 50MM & Below	ASTM A335 - P22	ASTM A182 - F22	ASTM A182 - F22	Spiral Wound SS 316	Socket Welded
7.18.03	Steam Temp. 400°C TO 510°C	NB 65MM & Above	ASTM A335 - P11	ASTM A234 - WP11	ASTM A182 - F11	Spiral Wound SS 316	Butt Welded
i)		NB 50MM & Below	ASTM A335 - P11	ASTM A182 - F11	ASTM A182 - F11	Spiral Wound SS 316	Socket Welded
7.18.04	Steam Below 400°C	NB 65MM & Above	ASTM A106 Gr.B	ASTM A234 - WPB	ASTM A105	Spiral Wound SS 316	Butt Welded



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Service	Size	Pipes	Fittings	Flange	Gaskets	Line Joint
i)		NB 50MM & Below	ASTM A106 Gr. B	ASTM A105	ASTM A105	Spiral Wound SS 316	Socket Welded
7.18.05	Feed Water / Condens ate	NB 65MM & Above	ASTM A106 Gr. C/B	ASTM A234 - WPC / WPB	ASTM A105	Spiral Wound SS 316	Butt Welded
i)		NB 50MM & Below	ASTM A106 Gr. C/B	ASTM A105	ASTM A105	Spiral Wound SS 316	Socket Welded
7.18.06	Lube Oil And Control/ Hydraulic Oil (Upstream of Filter)	NB 65MM & Above	ASTM A106 Gr. B	ASTM A234 - WPB	ASTM A105	Grafoil	Butt Welded
i)		NB 50MM & Below	ASTM A106 Gr.B	ASTM A105	ASTM A105	Grafoil	Socket Welded
7.18.07	Hydraulic Oil (Beyond Filter)	NB 65MM & Above	ASTM A 312 TP 316 (SEAM LESS)	ASTM A 403 GR. WP316	ASTM A182 F316	Grafoil	Butt Welded
i)		NB50 MM & Below	ASTM A 312 TP 316 (SEAM LESS)	ASTM A 403 GR. WP316	ASTM A182 F316	Grafoil	Socket Welded
7.18.08	Demineralised Water	NB 65MM TO 150 200 TO 350	ERW, BLACK, IS 1239 (PT-1) Heavy class Rubber lined IS 1978 ERW OR API 5L GR.B Rubber lined	ASTM A 234 GR. WPB Rubber Lined	ASTM A 105 Rubber Lined	Grafoil	Flanged
i)		NB 50MM & Below	ASTM A312 TP 304	A 182- F304	A 182- F304	Grafoil	Socket Welded
7.18.09	Auxiliary Cooling	NB 65 TO	ERW, BLACK IS	ASTM A234	ASTM A105	Grafoil	Butt Welded



GUJARAT STATE ELECTRICITY COPRORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Service	Size	Pipes	Fittings	Flange	Gaskets	Line Joint
	Water (Passivated DM Water), Service Water System (Fresh Water Application), Service Air System	150 200 TO 450	1239 Heavy class (PT-1) ERW, IS 1978 (OR) API 5L GR. B (OR) IS 3589 Fabricated from IS 2062	Gr.WPB	(A283G R-C for Above NB 200 MM)		
i)		500 & Above	IS 3589 Fabricated from IS 2062 Plates				
ii)		NB 50 MM & Below	ERW, BLACK, IS 1239 (PT-1)	ASTM A105	ASTM A105	Grafoil	Socket Welded
7.18.10	Potable Water System/ Instrument Air Service	NB 65 TO 150	ERW, BLACK, IS 1239 Heavy class (PT-1), Galvanised	ASTM A234 Gr.WPB Galvanised	ASTM A105 Galvanised	Grafoil	Flanged
i)		200 NB TO 450	IS 1978, ERW(OR) API 5L GR.B (OR) IS 3589 Fabricated From IS 2062 Plates (A LI Galvanised)				
ii)		NB 50 MM & Below	ERW, BLACK, IS 1239 (PT-1), Galvanised	ASTM A105 Galvanised	ASTM A105 Galvanised	Grafoil	Screwed
7.18.11	Light Diesel Oil (LDO)	NB 65MM & Above (Seam Less)	ASTM A 106 Gr. 'B'	ASTM A 234 WPB	ASTM A105	Teflon	Butt Welded



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Service	Size	Pipes	Fittings	Flange	Gaskets	Line Joint
i)		NB50M M & Below (Seam Less)	ASTM A 106 Gr. 'B'	ASTM A 105	AST M A105	Teflon	Socket Welded

Note:

- All mandatory tests shall be carried out as per ASME Boiler & Pressure Vessel Code ASME Section-II,
- Each length of pipe shall be hydro-tested at shop as per the Codes/Standards.
- Blind flanges on SS Pipe lines shall be to ASTM A 240-TP 316. Stub ends shall be used at flanged connections.
- All branch connections shall be wrought (seamless) or forged steel based on the size and availability based on ASTM Standards.
- All painting with primer coats (2 coats each) shall be provided for the piping and all hangers.

7.19.00 Specific Requirements for Valves

Sl. No.	Service	Size	Body/ Bonnet	Disc	Stem	Hand Wheel	Valve Ends
7.19.01	Steam Lines (Temp >550°C And 600°C)	>65 NB	ASTM A217 C- 12	ASTM A217 C-12	ASTM A182 Gr. F6a	ASTM A47 G Gr. 32510	Butt Welded Socket
i)		< 50 NB	ASTM A182 Gr.F-91	ASTM A182 Gr F91	ASTM A182 Gr. F6a	ASTM A97 Gr.32510	Welde d
7.19.02	Steam Lines (Temp 510°C And <550°C)	>65 NB	ASTM A217 WC-9	ASTM A217 WC- 9	ASTM A182 Gr. F6a	ASTM A47 G Gr. 32510	Butt Welded Socket
i)		< 50 NB	ASTM A182 Gr.F-22	ASTM A182 Gr F22	ASTM A182 Gr. F6a	ASTM A97 Gr.32510	Welde d
7.19.03	Steam Lines (temp>400°C And <510°C)	>65 NB	ASTM A217 WC-6	ASTM A217 WC-6	ASTM A182 Gr. F6a	ASTM A47 G Gr. 32510	Butt Welded Socket
i)		< 50 NB	ASTM A182 F11	ASTM A182 F11	ASTM A182 Gr. F6a	ASTM A97 Gr.32510	Welde d
7.19.04	Steam Lines (Temp<400°C), Condensate Blow Boiler Feed Suction Line	>65 NB	ASTM A216 Gr WCB	ASTM A216 Gr WCB	ASTM A182 Gr F6a	ASTM A47 Gr 32510	Butt Welded



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Service	Size	Body/ Bonnet	Disc	Stem	Hand Wheel	Valve Ends
i)		< 50 NB	ASTM A105	ASTM A182 Gr F6a	ASTM A182 Gr F6a	ASTM A47 Gr 32510	Socket Welded
7.19.05	Boiler Feed Discharge & Recirculation Systems	> 65	ASTM A 216 Gr. WCB/C	ASTM A 216 Gr. WCB/C	ASTM A 182 Gr. F6a	ASTM A 47 Gr. 32510	Butt Welded
i)		< 50	ASTM A 105	ASTM A 182 Gr. F6a	ASTM A 182 Gr. F6a	ASTM A 47 Gr. 32510	Socket Welded
7.19.06	Lube Oil, Sludge, Oily Water Drains (upto Filter)	>65 NB	ASTM A216 Gr WCB	ASTM A216 Gr WCB	ASTM A479 Type 410-2	ASTM A47 Gr 32510	Butt Welded
i)		< 50 NB	ASTM A105	ASTM A479 Type 410-2	ASTM A479 Type 410-2	ASTM A47 Gr 32510	Socket Welded
7.19.07	Boiler Feed Discharge & Recirculation Systems	>65N B < 50 NB	ASTM A 216 Gr. CB/C ASTM A 105	ASTM A 216 Gr. WCB/ C ASTM A 182 Gr. F6a	ASTM A 182 Gr. F6a	ASTM A 47 Gr. 32510	Butt Welded Socket Welded
7.19.08	Lube Oil, Sludge, Oily Water Drains (Upto Filter)	>65N B < 50 NB	ASTM A216 Gr WCB ASTM A105	ASTM A216 Gr WCB ASTM A479 Type 410-2	ASTM A479 Type 410-2 ASTM A479 Type 410-2	ASTM A47 Gr 32510	Butt Welded Socket Welded

7.20.00 Thermal Insulation for Hot Surfaces

Sl. No.	Item	Unit	Description
7.20.01	Insulation Material for		Lightly bonded mineral wool / pre-formed calcium silicate
7.20.02	Equipment		All equipment as applicable except steam turbine



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.20.03	Finishing Cement		No
7.20.04	Sheathing Material		Aluminium as per IS737 – 31000, Gr.H3
7.20.05	For pipes		
i)			Insulation outside dia above 450mm – Sheet thickness – 20 SWG.
ii)			Insulation outside dia 150 to 450mm – Sheet thickness – 22 SWG.
iii)			Insulation outside dia below 150mm – Sheet thickness – 24 SWG.
7.20.06	For Equipment		
i)			Flues & ducts – Sheet thickness 1.0mm
ii)			Boiler casing & rear wall enclosure – Sheet thickness 1.6mm.
7.20.07	Design thickness is / should be based on:		
i)	Station ambient temperature	°C	30
ii)	Outer surface temperature on surface of sheathing	°C	60 under still air condition
iii)	Recommended thickness furnished (Applicable for calcium silicate also)		Yes
7.20.08	Codes & Standards		IS 8183 IS 14164 BS 5970 IS-8154 BS 3958
7.20.09	For insulation thickness calculation maximum thermal conductivity indicated in relevant BIS shall be considered.		
7.20.10	Volume–III, Part-A, Section-3 will also be referred, and the more stringent requirement has to followed.		



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

7.21.00 Electrostatic Precipitators Datasheet

Sl. No.	Item	Unit	Description	
7.21.01	Number required		One ESP with four/six streams for steam generator offered by the bidder)	
7.21.02	Duty		Continuous, designed for 100% BMCR, guarantee point at 30 deg. C ambient air temperature and 66% RH. Designed taking Inlet dust burden shall be taken as 90% ash or actual predicted whichever is higher being carried forward to ESP while firing worst coal.	
7.21.03	DESIGN & CONSTRUCTION REQUIREMENTS		Guarantee point	Design point
i)	Type of coal blend		Design coal	Worst coal with maximum ash.
ii)	Gas flow per Boiler at ESP inlet when firing respective coal		To be worked out by bidder when firing the specified design coal at TGMCR load considering 20% excess air at economiser outlet, 15% air heater air in leakage & 2% duct leakage as a minimum. 10% dust concentration on ash loading of worst coal or % of ash content in coal whichever is higher shall also be considered_	To be worked out by bidder when firing the specified worst coal at BMCR load considering 20% excess air at economiser outlet, 15% air heater air-in leakage & 2% duct leakage as a minimum



GUJARAT STATE ELECTRICITY CORPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description	
iii)	Flue gas temperature at ESP inlet		125 [or] as predicted by the bidder under Stipulated condition above, whichever is higher	140 [or] as predicted by the bidder under stipulated condition above, whichever is higher
7.21.04	Electrode spacing	Mm	400	
7.21.05	SCA		Minimum. 180 m ² /m ³ /s	
7.21.06	Air infiltration in ESP		1% of ESP inlet gas flow	
i)	Number of Gas Streams		Four (4) / Six (6)	
ii)	Furnace condition		Balance draft, maximum flue gas velocity in ESP-1m/s	
iii)	Number of fields in series		Bidder to indicate	
iv)	Dust concentration at outlet of ESP with design and worst coal range. – (range of coal whichever gives maximum ash) –with one field out of service of each stream	mg/N m ³	27(max.)	
v)	Length to height ratio of collecting plate (Aspect ratio)		Not less than 1.5	
vi)	Specific collection plate area (total collecting plate area/total gas flow)	M ² /m ³ /s ec	Not less than 200	
vii)	Bulk ash density			
viii)	- For hopper capacity	kg/m ³	800	
ix)	- For hopper strength	kg/m ³	1600	
x)	Resistivity of ash	Ohm -cm	During Detailed Engineering	



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEM STEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
xi)	Minimum number of transformer rectifier sets/field		By Bidder
xii)	Minimum number of bus sections/field		By Bidder
xiii)	Minimum corona power density	Watts/ m ²	By Bidder
xiv)	Minimum current density	Micro amps/ m ²	By Bidder
7.21.07	Casing and hopper		
i)	Method of construction		Welded sheet metal
ii)	Casing design pressure		Compatible with furnace design pressure (With two fans operating, it shall be able to meet 120% BMCR flow, at 50 deg C ambient temperature and 47.5 to 52.5 Hz power supply frequency , guaranteed APH leakage and worst coal firing.+ 660mmwc at 67% of yield strength.)
iii)	Thickness of steel sheet	mm	Not less than 8mm
iv)	Storage capacity of dust hopper with worst coal firing (To be measured 600 mm below electrodes)		8 hrs. (minimum)
v)	Plate angle of dust hopper	degree s	Not less than 70
vi)	Elevation of hopper outlet flange	M	EL (+) 3.5
vii)	Hopper liners		3mm (min.) SS, for complete hopper
7.21.08	Type of discharge electrode		Spring type/rigid type
7.21.09	Type of collection electrode		Cold rolled solid sheet construction
i)	Thickness of collecting electrode plate		Not less than 18 gauge



GUJARAT STATE ELECTRICITY COPRORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.21.10	Items to be Provided		
i)	Inlet and outlet gas isolation dampers/ gates		Yes
ii)	Fly ash hoppers with panel type heaters, level indicators, outlet flange poke holes, access doors etc.		Yes
iii)	Thermal insulation and 1.1 mm aluminium corrugated cladding		Yes
iv)	Weather-proof enclosure for TR sets, insulator compartment with heaters, air blowers, filters, controls etc.		Yes
v)	Provision of water washing system (offload)		Yes
vi)	Test connections of std. size for measuring pressure, temperature, velocity, dust loading at inlet and outlet of precipitator		Yes
vii)	Interior access walkways minimum of 600 mm wide, exterior platforms, staircase on both sides, ladder, access doors and galvanized hand rails of 40 mm pipe etc.		Yes
viii)	Opacity monitor		Yes

7.22.00 Conveyor for Mill Reject

Sl. No.	Item	Unit	Description
7.22.01	Type of conveyor		Chain conveyor
7.22.02	Casing		Enclosed type (Dust Tight)
7.22.03	Required nos.	Nos.	As required as per Layout requirement
7.22.04	Material handled		Mill Rejects



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.22.05	Lump size of material	mm	(-) 40
7.22.06	Bulk density	T/M ³	1.6 for volumetric calculation and 2.4 for structural design
7.22.07	Operating Temperature	°C	Minimum 200
7.22.08	Capacity	TPH	As required
7.22.09	Elevator Profile		As per Layout requirement
7.22.10	conveyor speed	M/min	Maximum 10
7.22.11	Factor of safety		Minimum 6
7.22.12	Materials of construction		
i)	Casing		
ii)	Bottom Plate		10mm thk, AR 400
iii)	Side Plate		6mm Thk, IS: 2062 Grade B
iv)	Cover plate		3mm Thk, IS: 2062 Grade B
v)	End Plate		5mm Thk, IS: 2062 Grade B
vi)	Side wear liner		6mm thk, AR 400
vii)	Chain		Forged Alloy steel
viii)	Surface Hardness of Chain link		Case hardening, Hardness 57RC
ix)	Flight		16mm Thk, IS: 2062 Grade B
x)	Shaft		EN-24, Forged



GUJARAT STATE ELECTRICITY COPORATION LIMITED

VOLUME - III

**1X800 MW ULTRA SUPER CRITICAL UNIT NO#7 ON ASH DYKE
AREA AT UKAI TPS**

PART - A

BID SPECIFICATION NO.: ETG106-EPC-UKAI/UNIT # 7-TS-01

SECTION - 1

TECHNICAL SPECIFICATION STEAM GENERATOR & AUX.
INCLUDING DE-NOX SYSTEM AND MILL REJECT HANDLING
SYSTEMSTEAM GENERATOR & AUXILIARIES, ESP, DeNOx &
MRHS

REV. - 0

Sl. No.	Item	Unit	Description
7.22.13	Bearing		
i)	Type		Dust tight antifriction ball bearing
ii)	Life	h	30,000 (min)
7.22.14	Plummer block		Base mounted

7.23.00 Bucket Elevator for Mill Reject

Sl. No.	Item	Unit	Description
7.23.01	Type		Centrifugal Discharge
7.23.02	Required nos.	No.	One(01) no. for each mill Bay
7.23.03	Material handled		Mill Reject
7.23.04	Lump size of material	mm	(-) 40
7.23.05	Bulk density	T/M ³	1.6 for volumetric calculation and 2.4 for structural design
7.23.06	Capacity	TPH	As required
7.23.07	Operating Temperature	°C	Minimum 200
7.23.08	Moisture content (Maximum)	%	-----
7.23.09	Conveyor		Chain
7.23.10	Elevator Profile		Vertical
7.23.11	No. of inlet	No.	One (01) from Mill reject conveyor
7.23.12	No. of outlet	No.	One (01) discharge to Mill Reject silo



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REV. - 0

Sl. No.	Item	Unit	Description
7.23.13	Bucket Size		As required
7.23.14	Bucket filling factor	%	Maximum 75%
7.23.15	Bucket elevator conveyor speed	M/s	Maximum 1.5
7.23.16	Factor of safety		Minimum 6
7.23.17	Materials of construction		
i)	Casing		IS: 2062 Grade B, Dust Tight
ii)	Bucket		MS Reinforced
iii)	Shaft		EN-8, Forged steel
7.23.18	Bearing		
i)	Type		Dust tight antifriction ball bearing
ii)	Life	hr	30,000 (min)
iii)	Plummer block		Base mounted