TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
1.00.02.17	Ethernet Switches, Routers & other communication hardware	Nos.	10% of qty Installed of each type or a minimum of 2 numbers from each model, whichever is more.		
1.00.02.18	Sensors with special cables, Power supply modules, Relay, Interface Module, and electronic modules used for vibration monitoring system.	Nos.	10% of qty installed or Five no. (Whichever is more) of each type)		
1.00.02.19	Printer toners for all printers	Nos.	Not Applicable for this package		
1.00.02.20	DMP printer head of the total quantity	Nos.			
1.00.02.21	Drum for A3 sized scanner cum copies, printer	Nos.			
1.00.02.22	24“ LED monitor,	Nos.	Not Applicable. OWS shall be supplied as per applicability.		
1.00.02.23	29” LED monitor	Nos.			
1.00.02.24	22” LED monitors.	Nos.			
1.00.02.25	RJ 45 connector with box of each type	Nos.	Twenty (20) percent or 2 no. (Whichever is more)		
1.00.02.26	Hooters, Buzzers, Cooling fans of each type.	Nos.	Ten (10) percent or 2 no. (Whichever is more)		
1.00.02.27	Interface cables	Set	2 sets of each type/model		
1.00.02.28	Power supply modules (AC to DC convertors)	Nos.	10% or Five no. (Whichever is more) of each type/model		
1.00.02.29	DVD/CD drive unit of each type	Nos.	Not Applicable for this package		

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
1.00.02.30	Mouse	Nos.	Not Applicable for this package		
1.00.03	**Steam and Water Analysis System (SWAS)**			50,56,170	Lot price has been given for items under Sl no. 10.00.03
1.00.03.01	High pressure reducing elements for sample flow.	Nos.	10% spare of qty installed.		
1.00.03.02	Ion exchange columns with resin as utilized with cation conductivity analysers	Nos.	Four No		
1.00.03.03	Conductivity cells as utilised with conductivity monitors	Nos.	Two nos of each type		
1.00.03.04	pH flow-through type cells used with pH monitors	Nos.	Two nos. of each type		
1.00.03.05	Chemical reagents for all analysers	Set	12 months continuous operation of all analysers from date of taking over.		
1.00.03.06	Chemical reagents for colorimetric silica analyzers	Set	12 months continuous operation of all analysers from date of taking over.		
1.00.03.07	Electronic Modules	Nos.	One (1) no. for each type of Analyser.		
1.00.03.08	Pressure gauge, solenoid valves, temperature gauge, Back Pressure regulating valves, 3 way grab valves, needle valves, isolation valves, PRV, flow switch, flow indicator and temperature switch, erection hardware's, valves in SWAS.	Nos.	Two (2) no. of each type		
1.00.03.09	Primary coolers/secondary coolers.	Nos.	Three (3) No of each type		
1.00.04	**Relay based Control Panels**				
1.00.04.01	LEDs for indicating lights	Nos.	10% of qty installed.		
1.00.04.02	Control circuit fuses/MCB/MCCB/ Semiconductor Fuses	Nos.	300% of installed of each type, current rating.		
1.00.04.03	Relays modules & contactors.	Nos.	20% spare of qty Installed of each type & rating.		

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
1.00.05	**Alarm Annunciation System**				
1.00.05.01	logic modules, group card modules, power supply modules, Hooters and any other electronic module.	Nos.	20% spares of each type installed		
1.00.05.02	un-engraved window boxes complete with LED etc.	Nos.	5% spares of each size installed		
1.00.05.03	LEDs for annunciation facia windows and LEDs box assemblies offered for the project	Nos.	20% of qty installed		
1.00.05.04	Annunciator hooter	Nos.	One (1) No. of each type		
1.00.06	**Un-interrupted Power Supply System and DC Control Power Supply System**				
1.00.06.01	As per Manufacturer's Recommendation for Three Years Continuous Operation or minimum quantities indicated as below (whichever is more)				
1.00.06.02	Fuses/Semiconductor Fuses	Nos.	300% of installed of each type, current rating with each panel /board		
1.00.06.03	Miscellaneous parts for the power supplies such as SCRS, transistors, resistors, diodes, light bulbs, static switches , blocking diodes etc	Nos.	Minimum of 10% or atleast two (which ever is more) of each type		
1.00.06.04	Battery cells complete with contactor,cover plates etc	Nos.	10% of qty installed		
1.00.06.05	Electronic Modules like Rectifier control card, inverter control card, Driver card, IGBT Module, DC-DC converter card or any other card as listed in approved BOM for UPS, AC supply & 24 V DC supply etc.	Set	1 Set of each type & rating		

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
1.00.06.06	Miniature Circuit breakers for AC and DC supply.	Nos.	20 % of installed or 10 Nos of each type (which ever is more) for ACDB and DCDB.		
1.00.06.07	Digital/analog panel meters/indicators	Nos.	5% or 2 no. of each type (whichever is more)		
1.00.06.08	CT's, CVT's VT's chokes, AC/DC isolators, contactors, timers, relays.	Nos.	10% or 2 nos. of each type and rating, (whichever is more)		
1.00.06.09	Cooling Fans in UPS & 24 V DC charger panels	Nos.	10% or 2 nos. of each type and rating, (whichever is more)		
1.00.06.10	following accessory equipment for the battery shall be furnished :	Set	Two sets		
	a) Cell lifting facilities				
	b) Assembly wrenches				
	c) Vent plug hydrometer d) Vent plug thermometer				
	e) Supply of corrosion-preventive grease.				
	f) 10% spare cells.				
1.00.06.11	Electronic modules of each type & rating for UPS and DC control power supply system.	Set	One set of with each set consisting of at least one number of each type of electronic module for inverters, chargers, static switch, stabiliser etc. as per approved BOM.		
1.00.06.12	MCCB for UPS & 24 V DC charger panels, ACDB, DCDB.	Nos.	20 % of installed or 5 Nos of each type (whish ever is more)		
1.00.07	**Erection hardware**				
1.00.07.01	Instrument valves	Nos.	Ten (10) percent of each type & Size installed		

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
1.00.07.02	Condensate pots of each type & Size installed	Nos.	Ten (10) percent of total number of Installed or four numbers whichever is higher .		
1.00.07.03	Manifold	Nos.	Ten (10) percent of each type & Size installed		
1.00.07.04	Fittings	Nos.	Ten (10) percent of each type & Size installed		
1.00.08	**LVS**			8,58,305	EDN-Lot price has been given for items Sl no 1.00.08
1.00.08.01	LEDs	Nos.	20% (Installed) spares of each type & size.		
1.00.08.02	LVS Filters	Nos.	50% spare or min 6 nos.		
1.00.08.03	Electronic cards of each type for LVS	Nos.	3 nos. or 20% whichever is more		
1.00.08.04	Interfacing cables	Set	Two Set of each type & size.		
1.00.08.05	Power supply modules of each type for LVS	Nos.	3 nos. or 20% whichever is more		
1.00.08.06	Cooling modules of each type for LVS	Nos.	3 nos. or 20% whichever is more		
1.00.08.07	LVS Controller of each type for LVS	Nos.	2 nos.		
1.00.09	**Master Slave Clock system**			1,45,950	EDN-Lot price has been given for items Sl no 1.00.09
(i)	As per Manufacturer's Recommendation for Three Years Continuous Operation or minimum quantities indicated as below (whichever is more)	Set			
(ii)	Electronic cards	Nos.	One No. of each type & model		
(iii)	Signal Conditioner cards	Nos.	One No. of each type & model		
(iv)	Slave clocks of each type used for Master slave clock system	Nos.	Two No. of each type & model		
(v)	Cubicle power supply power supply modules	Nos.	Ten (10) percent or 2 nos (whichever is more) of Installed of each type and rating		
1.00.10	**Plant Security and survillance system**			5,10,020	EDN-Lot price has been given for items Sl no 1.00.10

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	**Name of spares**	**Unit**	**Qty**	**in INR**	
1.00.10.01	As per Manufacturer's Recommendation for Three Years Continuous Operation or minimum quantities indicated as below (whichever is more)				
1.00.10.02	Electronic cards	Nos.	One No. of each type		
1.00.10.03	PTZ controller	Nos.	One No. of each type		
1.00.10.04	Electronic modules used for server system	Nos.	10% or Two No. of each type (whichever is more)		
1.00.10.05	Special cables & connector	Set	(5 sets) of each type		
1.00.10.06	Cartridges for air filter	Nos.	Two No. of each type		
1.00.10.07	Relay	Nos.	5 nos. of each type		
1.00.10.08	Power supply modules of each type	Nos.	5 nos. of each type		
1.00.10.09	Camera of each type used for Plant Security and surveilance system.	Nos.	Two no. of each type		
1.00.10.10	Automatic door sensors	Nos.	10% or 2 nos. min whichever is more		
1.00.10.11	Card reader.	Nos.	10% or 2 nos. min whichever is more		
1.00.11	**AAQMS**			27,12,500	Lot price for applicable items
1.00.11.01	As per Manufacturer's Recommendation for Three Years Continuous Operation or minimum quantities indicated as below (whichever is more)				
1.00.11.02	Electronic cards/Module/Mother Board /Signal Processing Unit for each type of Analyzer	Nos.	One no. of each type		
1.00.11.03	Power supply module	Nos.	One no. of each type for each analyser		
1.00.11.04	UV Lamp with adopter with SO2 analyser.	Nos.	One no. of each type		
1.00.11.05	Light source and detector unit for SPM, and NOX/SOX analyser.	Nos.	One no. of each type for each analyser		
1.00.11.06	Pump for SPM Analyser	Nos.	One no. of each type		
1.00.11.07	Conference hall mic.	Nos.	Two no. of each type		
1.00.11.08	Conference hall speakers.	Nos.	Two no. of each type		
1.00.12	**HMS**			90,475	
1.00.12.01	As per Manufacturer's Recommendation for Three Years Continuous Operation	Set			
1.00.12.02	Electronic cards	Nos.	One no. of each type		

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
1.00.13	**Mandatory Spares for Control valves, Power Cylinder, Control Dampers, Actuators and Accessories**				
(A)	Following spares shall be furnished for control valves, Power Cylinder, Control Dampers as applicable.				
	One set of spare control valve stem packing for each control valve.				
	Two moulded rubber diaphragms for each control valve.				
	One sets of each of O-rings and rubber gaskets for each control valve.				
d)	100 percent qty. of lubricants for gaskets for each control valve on one year consumption basis.				

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
	2 sets of limit switches and 1 set of valve positioner for each control valve.				
f)	20 percent of position transmitter (4-20mA) for total qty. of control valve.				
g)	One (1) set of valve trims (such as plug, stem, seat ring /cage, guide bushing, stem lock pin, packing retaining ring, etc) for each control valve.				
h)	One completes actuator of each type or min 10% for each type and size whichever is more.				
i)	20 percent of Solenoid valves or min 2 no. of each type for total qty. of control valves.				
j)	20% of I to P converters, Pressure regulators.				
B)	Mandatory spares for each critical applications special control valves as specified in NIT			1,17,72,635	PEM-For APRDS AND For Fuel Oil Unloading System, included under clause Fuel oil system of Mech. List of mandatory spares AND For Air Conditioning system, price included under clause Air Conditioning system of Mech. List of mandatory spares
C)					

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
a.	Soft Goods Kit Valve	1 set		65,16,048	PEM-For Fuel Oil Unloading System, included under clause Fuel oil system of Mech. List of mandatory spares AND For Air Conditioning system, price included under clause Air Conditioning system of Mech. List of mandatory spares
b.	Metal seat	1 set			HYD-Lot price has been given for items under SL no.1.00.13 (C) Items applicable for Pumps shall be supplied.
c.	Seat Ring	1 set			For C&I control valves included above under clause no A1 -1.0013 of C&I list AND For Fuel Oil Unloading System, included under clause Fuel oil system of Mech. List of mandatory spares AND For Air Conditioning system, price included under clause Air Conditioning system of Mech. List of mandatory spares
d.	Spindle	1 set			
e.	Actuator Soft Goods kit	1 set			
i.	Feed back transmitter unit	2 Nos.			
ii.	Electronic Position Transmitter	2 Nos.			
iii.	Solenoid valves	2 Nos.			
iv.	Air filter regulators	2 Nos.			
v.	Air Lock Relay	2 Nos.			
vi.	Complete Actuator for each type and model	1 set			
C)	Following spares shall be supplied for each of the HP/LP By Pass & Spray control valves				TRY-V: Price already Quoted in Mechanical section under HP BYPASS SYSTEM
i)	Stem	1 NO.			
ii)	Jet Cage	1 NO.			
iii)	Nozzle Body	1 NO.			
iv)	Seat	1 NO.			
v)	Guide bushing	1 NO			
vi)	Valve Packing	1 Set			
vii)	Valve Gaskets	1Set			
viii)	Actuator seal set	1 Set			
D)	Common spares for HP/LP By Pass & Spray control valves:				TRY-V: Price already Quoted in Mechanical section

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	**Name of spares**	**Unit**	**Qty**	**in INR**	
i)	Feedback transmitter	2 NOS.			under HP BYPASS SYSTEM
ii)	Electronic positioner	2 NOS.			
iii)	Proportional Valve	2 NOS.			
iv)	Quick opening device	2 NOS.			
v)	Seal sets	4 Sets			
vi)	Solenoid Valves	2 NOS.			
vi)	Filters for Oil Units	1 set			
vii)	Supply manifold for oil units	1 No			
viii)	Hose for each service	1 each			
ix)	Seal set for oil unit	1 Set			
x)	Complete actuator for each type and model	1 set			
E)	1 NO of Nozzle for each PRDS De Super heater & Spray water desuperheater and orifice plate for CEP flow.				1 No. Nozzle for Spray water Desuperheater is included in our price. Rest of the flow nozzles not included in our offer as 'Mandatory spares' are provided for items or components that require replacement during plant operation. Flow nozzles and orifice plates do not require replacement and hence are not provided as mandatory spares. We have never supplied nozzles and orifice plate as mandatory spares in any of the existing as well as previous projects.
1.00.14	**Mandatory Spares for Boiler Tube leak Detection System**			17,81,920	LOT PRICE FOR THE APPLICABLE ITEMS UNDER THIS SERIAL NO 1.00.14
	Following mandatory spares along with their individual price required for maintaining boiler tube leak detection system to supply along with the package.				
1)	2nos. acoustic transducer with rear connector sealed to IP-65				
2)	2 nos. flexible high temperatures lead, 3metre long for acoustic transducer.				
3)	2 nos. acoustic s field amplifier / processor mounted in a die cast aluminum or polycarbonate box sealed to IP-65 with mounting brackets, pairs.				
4)	1 no. A/D Convertor cards/field signal interface module for 32 or more channels.				
5)	1 no. Alarm relay output card.				

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
6)	Consumables like batteries, fuses etc. for two years operation of boiler tube leak detection system.				
1.00.15	**Mandatory spares not covered above**				
	Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument, instrumentation/mechanical fittings etc for any other electronic system, feeder control cabinets, hydrastep (EWLI), Vibration Monitoring System, CCTV, C&I Lab Instruments, On line Carbon in Ash analyser system, On line Coal mass flow/speed measurement system, On line secondary air flow measurement system Mass Flow meter, Solid flow meter, 3 D Acoustic type level transmitters, Nucleonic & non nucleonic density transmitter etc.				
1.00.16	**OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS/EQUIPMENTS**				
1.00.16.01	**Other SG related sub-systems**				
1	**Flame Monitoring System**				
(i)	Complete Flame Scanner Assembly including scanner head assembly, scanner housing, and fibre optic cables.	20% or 4 nos. whichever is more.		39,05,356	
(ii)	Flame Scanner Lens.	100%		1,08,570	
(iii)	Electronic cards for scanners	10% or 2 nos. of each type whichever is more.		17,69,852	
(iv)	Power Supply Modules	10% or 2 nos. of each type whichever is more.			INCLUDED IN SL NO (III) ABOVE
2	**Coal Feeders**				
(i)	Calibration Motor	10% or 2 nos. whichever is more.			NOT APPLICABLE
(ii)	Correction Motor	10% or 2 nos. whichever is more.			NOT APPLICABLE

C&I Mandatory spares are indicated in above list. These spares shall be considered as per the applicable items in main supply of respective packages.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
(iii)	Motion monitor	10% or 2 nos. whichever is more.		8,14,275	
(iv)	Speed pick-up	10% or 2 nos. whichever is more.		5,69,989	
(v)	Torque switch	10% or 2 nos. whichever is more.		15,30,746	
(vi)	Load Cell	10% or 2 nos. whichever is more.		62,19,969	
(vii)	Electronic cards & Power Supply cards	10% or 2 nos. whichever is more.		12,15,725	
(viii)	Clutch (if applicable)	10% or 2 nos. whichever is more.		8,14,275	
(ix)	Local indication lamps	200% .		4,14,316	
(x)	Panel meters	10% or 2 nos. whichever is more.			NOT APPLICABLE
(xi)	Limit switch assembly for coal-on-belt, no coal flow, shear pin failure, etc.	10% or 2 nos. whichever is more.		3,79,995	
(xii)	Coupling (eddy current type etc., if applicable)	10% or 2 nos. whichever is more.		3,79,995	
3	**Electromatic Safety Valves**				
(a)	Pressure switches, local PB stations and solenoid Valves.	10% or 2 nos. of each type whichever is more.		4,07,498	
4	**Furnace Temperature Probes**				
(a)	Thermocouple	2 Nos. of each type		67,900	
5	**Acoustic Pyrometers**				NOT APPLICABLE
(a)	Signal Processor and interface modules	10% or 2 nos. of each type and model whichever is more			NOT APPLICABLE
(b)	Sensors and Transceivers	20% or 2 nos. of each type and model which is more.			NOT APPLICABLE
6	**Furnace and Flame Viewing System**			40,25,000	LOT PRICE FOR THE APPLICABLE ITEMS UNDER THIS SL NO
(a)	Flame Cameras	10% or 2 nos. of each type whichever is more.			
(b)	Electronic Modules	10% or 2 nos. of each type whichever is more.			
7	**Coal Bunker Level Indicating System**			1,69,680	EDN -lot price has been given for the itmes under Sl no 7 to 8
(i)	Sensors of each type	20% or 2 nos. of each type whichever is more.			

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	Name of spares	Unit	Qty	in INR	
(ii)	Electronic Cards of each types, model	10% or 2 nos. of each type and model whichever is more.			
(iii)	Panel indicators/displaysfor Bunker Level	20% or 2 nos. of each type whichever is more.			
8 (i)	Solenoids for SG pneumatic drives/valves.	20% or 2 nos. of each type whichever is more.			
(ii)	Solenoid valves.	20% or 2 nos. of each type whichever is more.			
(iii)	Diaphragms	20% or 2 nos. of each type whichever is more.			
9	**Conductivity type level monitoring system**				NOT APPLICABLE
(i)	Electrodes	50% of population of each type and model.			NOT APPLICABLE
(ii)	Electronic Cards	20% or 2 nos. of each type and model whichever is more.			NOT APPLICABLE
(iii)	Lamps/LEDs of display units	100%			NOT APPLICABLE
10	Mill and Air heater Fire detection system.			63,672	Included in Sl No 1.00.01 & 1.00.02 for EDN scope of supply and lot price indicated here is for Trichy's scope of supply.
(a)	Thermocouple	10% or 2 nos. whichever is more		-	
(b)	Process actuated switches	10% or 1 no. whichever is more			NOT APPLICABLE
(c)	Electronic cards	20% or 2 nos. whichever is more			NOT APPLICABLE
1.00.16.02	**Other TG Related Sub-Systems**				
	Turbine Supervisory System/EHTC/TSC/ATT/ATRS/GSPC/TDBFP etc.				EDN portion is Included in Sl No 1.00.01 & 1.00.0
(i)	Power Supply assemblies of all types	10% or 2 nos. of each type whichever is more		11,81,034	HYD- Lot price for items under for the Sl no (i) to (viii)
	Temperature Sensing elements	10% or 2 nos. of each type whichever is more			Already covered under S.No.1.00.01.02 (i) above, Hence,not offered again.
(iii)	CJC assemblies of all types	10% or 2 nos. of each type whichever is more			
(iv)	Local gauges/transmitters of all types, range, model no. etc. For Temperature, pressure, DP, differential expansion, axial shift etc.	5% or 1 no. of each type whichever is more			Already covered under S.No.1.00.01.03 above. Hence,not offered again.

TANGEDCO				Total Ex-Works price	*Remarks
Sl no	**Name of spares**	**Unit**	**Qty**	**in INR**	
(v)	Process Actuated Switch Devices of all types, range, model no. etc. for pressure, DP, temperature, flow, level, proximity/speed etc.	5% or 1 no. of each typewhichever is more			Already covered under S.No.1.00.01.03 above. Hence,not offered again.
(vi)	Electronic Cards/PCB's/interface units/special cables etc. of each type of measurement used in TSI.	10% or 2 nos. of each type whichever is more.			
(vii)	Instrument valves of all types like isolating, 2/3/5 way valve manifolds, hi pressure reducing, safety relief, each type of solenoid valves etc.	5% or 2 nos. of each type, model etc.; whichever is more.		1,74,230	
(viii)	Sensors of all types, range, model etc. for vibration, eccentricity, proximity, differential expansion, axial shift , EHC position, Stop/Control valve position and any other measurements etc.	10% or 2 nos. of each type whichever is more.			Sensors for Stop/ control valve position are already covered above under C&I spares. Hence,same are not offered again. For rest of measurements, the senors are "Not applicable"..
(ix)	Electro Hydraulic Converter.	1 complete unit of each type.		5,74,276	
			C& I TOTAL	26,12,61,835	

2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI

TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM

ANNEXURE-V

(DOC REQUIRED DURING BIDDING STAGE)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

Bidder shall submit following drawings / documents along with their bid:

a. Copy of pre-bid clarification, if any, duly signed and stamped.
b. Copy of electrical scope between BHEL & vendor dully signed and stamped.
c. Electrical equipment specification for Fuel oil system duly signed and stamped.
d. Electrical load list dully filled
e. Deviation schedule with reference to specific clauses of the specification along with reason for such deviation.
f. Copy of unpriced price bid indicating “QUOTED / NOT QUOTED” / “ NOT APPLICABLE” as the case may be.
g. Copy of drwg/doc schedule given at ANNEX-VI dully signed and stamped.

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF THE ABOVE DOCUMENTS.

DOCUMENTS OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND ACCORDINIGLY WILL NOT BE CONSIDRED FOR BID EVALUATION.

2X660MW ENNORE SEZ COAL BASED STPS

TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM

ANNEXURE-VI

(DRWGS/DOCS REQUIRED DURING DETAIL ENGINEERING)

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

DRAWING / DOC SUBMISSION SCHEDULE DURING DEAIL ENGINEERING

PACKAGE : FUEL OIL UNLOADING & STORAGE SYSTEM

Sl No	Drawing NO	Drg Title	Sch submission week from LOI	Category	Resubmission after ancorporating comments
1	PE-V0-412-166-A001	P&ID'S OF FOHS	4	A-CUST	WITHIN 1 WEEK
2	PE-V0-412-166-A002	CONTROL PHILOSPHY OF FOHS	4	A-CUST	WITHIN 1 WEEK
3	PE-V0-412-166-A003	DESIGN CALCULATION OF TANKS FOR FOHS	6	I-CUST	WITHIN 1 WEEK
4	PE-V0-412-166-A004	SIZING CALCULATION OF UTILITIES OF FOHS	4	I-CUST	WITHIN 1 WEEK
5	PE-V0-412-166-A005	DATASHEET & GAD OF SCREW PUMPS & MOTORS FOR FOHS	12	I-CUST	WITHIN 1 WEEK
6	PE-V0-412-166-A006	NPSH AND PUMP HEAD CALULATION OF PUMPS FOR FOHS	6	I-CUST	WITHIN 1 WEEK
7	PE-V0-412-166-A007	DESIGN CALCULATION AND GAD OF SUCTION HEATER FOR FOHS	10	I-CUST	WITHIN 1 WEEK
8	PE-V0-412-166-A008	DESIGN CALCULATION OF ELECTRIC TRACING OF LINES FOR FOHS	12	I-CUST	WITHIN 1 WEEK
9	PE-V0-412-166-A010	DESIGN CALCULATION AND GAD OF OWS FOR FOHS	8	I-CUST	WITHIN 1 WEEK
10	PE-V0-412-166-A012	PAINTING SCHEDULE OF FOHS	4	I-CUST	WITHIN 1 WEEK
11	PE-V0-412-166-A013	DS AND GAD OF PRS, TCV, TRAP, INSULATION AND CLADDING FOR FOHS	14	I-CUST	WITHIN 1 WEEK

12	PE-V0-412-166-A014	DATASHEET OF FOHS INSTRUMENTS	10	I-CUST	WITHIN 1 WEEK
13	PE-V0-412-166-A016	PIPING LAYOUT IN TANK FARM AREA OF FOHS	10	A-CUST	WITHIN 1 WEEK
14	PE-V0-412-166-A017	PIPING LAYOUT IN UNLOADING PUMP HOUSE OF FOHS	10	A-CUST	WITHIN 1 WEEK
15	PE-V0-412-166-A018	GAD OF FOHS (COMPOSITE LAYOUT)	12	A-CUST	WITHIN 1 WEEK
16	PE-V0-412-166-A019	SUGGESTIVE ELECTRICAL LAYOUT DRAWING OF FOHS	10	I-G-P	WITHIN 1 WEEK
17	PE-V0-412-166-A021	GAD OF FOHS TANKS INCLUDING ROOF STRUCTURE & NOZZLE ORIENTATION	10	I-CUST	WITHIN 1 WEEK
18	PE-V0-412-166-A023	FABRICATION DRAWING OF FOHS TANKS INCLUDING ACCESSORIES	18	I-CUST	WITHIN 1 WEEK
19	PE-V0-412-166-A024	DESIGN CALCULATION & GAD OF MISCELLANEOUS TANKS FOR FOHS	10	I-CUST	WITHIN 1 WEEK
20	PE-V0-412-166-A025	CIVIL INPUT DRAWING IN TANK FARM AREA FOR FOHS	16	I-CUST	WITHIN 1 WEEK
21	PE-V0-412-166-A026	QAP OF SCREW PUMP & MOTORS FOR FOHS	14	I-CUST	WITHIN 1 WEEK
22	PE-V0-412-166-A027	QAP OF PRS, TCV, TRAP, INSULATION AND CLADDING FOR FOHS	16	I-CUST	WITHIN 1 WEEK
23	PE-V0-412-166-A028	QAP OF SUMP PUMP & MOTORS FOR FOHS	14	I-CUST	WITHIN 1 WEEK
24	PE-V0-412-166-A029	QAP OF FOHS INSTRUMENTS	16	I-CUST	WITHIN 1 WEEK
25	PE-V0-412-166-A030	QAP OF CONTROL PANEL	16	I-CUST	WITHIN 1 WEEK

26	PE-V0-412-166-A031	EQUIPMENT SCHEDULES OF FOHS	20	I-G-P	WITHIN 1 WEEK
27	PE-V0-412-166-A032	CABLE SCHEDULE OF FOHS	16	I-G-P	WITHIN 1 WEEK
28	PE-V0-412-166-A033	ELECTRICAL LOAD DATA OF FOHS	16	I-G-P	WITHIN 1 WEEK
29	PE-V0-412-166-A034	ISOMETRIC DRAWING OF FOHS	10	I-G-P	WITHIN 1 WEEK
30	PE-V0-412-166-A035	SUB-VENDOR LIST WITH INSPECTION CATEGORIZATION LIST FOR FOHS	4	A-CUST	WITHIN 1 WEEK
31	PE-V0-412-166-A036	INSTRUMENT INSTALLATION DIAGRAM OF FOHS	20	I-CUST	WITHIN 1 WEEK
32	PE-V0-412-166-A038	INSULATION AND CLADDING SCHEDULE FOR FOHS	20	I-G-P	WITHIN 1 WEEK
33	PE-V0-412-166-A039	INSULATION I& CLADDING NSTALLATION PROCEDURE FOR FOHS EQUIPMENTS	20	I-G-P	WITHIN 1 WEEK
34	PE-V0-412-166-A040	STEAM TRACING INSTALLATION PROCEDURE	20	I-G-P	WITHIN 1 WEEK
35	PE-V0-412-166-A042	COMMISSIONING PROCEDURE OF FOHS	20	I-G-P	WITHIN 1 WEEK
36	PE-V0-412-166-A044	O&M MANUAL OF FOHS	20	I-CUST	WITHIN 1 WEEK
37	PE-V0-412-166-A045	DEMONSTRATION TEST PROCEDURE OF FOHS	20	A-CUST	WITHIN 1 WEEK
38	PE-V0-412-166-A046	CONTROL SCHEME/ LOGIC DIAGRAM FOR FOHS (DCS BASED)	20	I-G-P	WITHIN 1 WEEK
39	PE-V0-412-166-A047	PROCESS MANUSCRIPT FOR IMPLEMENTATION IN DCS FOR FOHS	16	I-G-P	WITHIN 1 WEEK
40	PE-V0-412-166-A048	DATASHEET & GAD OF SUMP PUMPS & MOTORS IN FOHS	12	I-CUST	WITHIN 1 WEEK

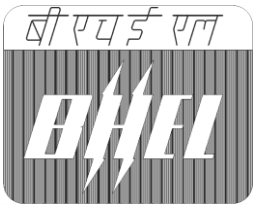
41	PE-V0-412-166-A049	DS AND GAD OF VALVES, HOSE AND STRAINER	14	I-CUST	WITHIN 1 WEEK
42	PE-V0-412-166-A050	DS AND GAD PIPES, PLATES AND FITTINGS ETC FOR FOHS	14	I-CUST	WITHIN 1 WEEK
43	PE-V0-412-166-A051	PIPING LAYOUT IN UNLOADING AREA OF FOHS	10	A-CUST	WITHIN 1 WEEK
44	PE-V0-412-166-A053	CIVIL INPUT DRAWING IN UNLOADING PUMP HOUSE OF FOHS	16	I-CUST	WITHIN 1 WEEK
45	PE-V0-412-166-A054	CIVIL INPUT DRAWING IN UNLOADING AREA OF FOHS	16	I-CUST	WITHIN 1 WEEK
46	PE-V0-412-166-A056	QAP OF VALVES, HOSE AND STRAINER FOR FOHS	16	I-CUST	WITHIN 1 WEEK
47	PE-V0-412-166-A057	QAP OF PIPES, PLATES AND FITTINGS ETC FOR FOHS	14	I-CUST	WITHIN 1 WEEK
48	PE-V0-412-166-A062	DS OF FLOWMETER FOR FOHS	10	I-CUST	WITHIN 1 WEEK
49	PE-V0-412-166-A063	QAP OF FLOWMETER FOR FOHS	16	I-CUST	WITHIN 1 WEEK
50	PE-V0-412-166-A064	ERECTION PROCEDURE OF ALL EQUIPMENT IN FOHS SCOPE	18	I-G-P	WITHIN 1 WEEK
51	PE-V0-412-166-A065	GAD OF OTHER MISCELLANEOUS ITEMS IN FOHS	10	I-CUST	WITHIN 1 WEEK
52	PE-V0-412-166-A066	DS OF OTHER MISCELLANEOUS ITEMS IN FOHS	10	I-CUST	WITHIN 1 WEEK
53	PE-V0-412-166-A067	QAP OF OTHER MISCELLANEOUS ITEMS IN FOHS	12	I-CUST	WITHIN 1 WEEK
54	PE-V0-412-166-A068	GA AND WIRING DIAGRAM OF ELECTRICAL TRACING PANEL	12	I-CUST	WITHIN 1 WEEK

2X660 MW ENNORE SEZ COAL BASED STPS

TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM

ANNEXURE-VII

(CUSTOMER SPECIFICATION)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

CHAPTER 15

15.0 FUEL OIL HANDLING SYSTEM

15.1 SCOPE

The scope covers the design, engineering, manufacture, supply, assembly and testing at manufacturer's works, inspection, packing, forwarding, delivery FOR site and handling with storage at site (i.e. taking delivery of materials from carriers, transportation to site), fabrication (as needed), erection, trial run, testing and commissioning including painting protection of fuel oil handling system covering oil storage tanks with unloading pump sets and associated oil, water and air pipe work materials, electricals & control instrumentation as well as civil works as needed for the plant facilities complete in all respects within the boundary limits.

The statutory approval for fuel oil unloading, transfer and storage system from Chief Controller of Explosives shall be obtained by the bidder. It shall be a part of scope of this specification along with any fees/ inspection charges and Bidder shall be responsible for obtaining the necessary approval. Owner shall furnish the required assistance for filing application/ documents.

15.2 SYSTEM DESCRIPTION

a) The fuel oil will be transported to the plant site by road tankers; and unloading pumps shall be used for unloading of oil and storing it in tanks. Before unloading the heavy fuel oil, it shall be heated by electric heaters in the road tankers as considered necessary to make it flowable. Fuel oil decanting pumphouse is also included in scope of bidder.

b) The heavy fuel oil shall be heated in the storage tanks to maintain a suitable temperature by supplying steam through floor coil heaters. The steam shall be provided from auxiliary Boiler. Heavy fuel oil tanks shall also be provided with suction heaters with steam as the heating source to heat the oil before sending it to pressuring units.

c) There shall be pipe nozzle provisions on the storage tanks in regard to heavy fuel oil recirculation from the boiler front. An adequately sized non-return valve shall be provided in each line connecting the fuel oil unloading headers and unloading pump suction header.

d) The heavy fuel oil will be pumped from the storage tanks to boilers front by pressuring units. The heavy fuel oil return from pressurizing units and burner headers will be brought back to respective storage tanks. Similarly, the light diesel oil will be pumped from HSD storage tank to boiler; and to hot gas generator by pressurizing units.

e) An oil water separator (to separate oil to the extent of max. 10 ppm oil left in the water) shall be provided close to the dyke area and unloading oil headers area to receive oil from the drain trenches, dyke area and unloading area. Oil from the oil water separator shall be returned back to the heavy fuel oil tanks by the help of two (2) 100 percent capacity oil recovery pumps. The water after suitable treatment shall be discharged to the surface drain.

f) All the heavy fuel oil lines, oil pumps and strainers shall be electric traced.

g) One (1) – 150 NB (min.) heavy fuel oil unloading manifold complete with eight (8) stand pipes with flexible hoses of 8 M length [each provided with universal type couplings, isolation valves and matching pieces as required for connecting to road tankers isolation valves and caps as required for connecting to road tankers. Tapping points on the oil header shall be suitably located.

h) Heavy fuel oil road tankers shall be fitted with electric heating coils so that oil may be heated to reduce its viscosity. When the oil temperature in tanker rises to about 50°C, oil shall be drained to the oil-unloading header. When the oil unloading header and the piping at the unloading pump suction is filled up with oil and steady oil supply is ensured, the unloading pumps shall be started.

i) One (1) 150 NB HSD unloading manifold completed with eight (8) stand pipes with flexible hoses of 8 M length each shall be provided with universal type couplings and matching pieces as required for connecting to road tankers. Tapping points on the oil header shall be suitably located.

15.3 REQUIRED EQUIPMENT AND SERVICES

The fuel oil handling system facilities to be supplied and furnished with all accessories and services under this specification shall include but be not limited to the following:

15.3.1 Oil Unloading Pump sets

15.3.1.1 a) Three (3) - 100 cum per hour capacity (2W+1S), 4 kg/cm2(g) discharge pressure, direct AC driven horizontal twin screw type heavy fuel oil unloading pump sets complete with AC electric motor drives and all other accessories as necessary. The pumps shall be electrically traced.

b) Two (2) – 50 cum per hour capacity (1W+1S), 4 kg/cm2(g) discharge pressure, direct AC driven horizontal twin screw type HSD unloading pump sets complete with drive motor with accessories for unloading road tankers.

c) Simplex type strainers (one for each pump) each having a capacity equal to that of the pump with isolating valves, drain valves, vent valves with goose neck piping and other accessories.

15.3.1.2 Common base frame skid for the pump sets, strainers and valves etc drain rim type with drip tray arrangement; and valved outlet connection, foundation bolts & nuts etc. Anchor bolts, sleeves, inserts, sole plates, lifting lugs, eye-bolts etc shall be supplied.

15.3.1.3 Bidder shall offer all parts, components etc which are necessary for efficient economic and safe operation of the pump sets skid irrespective of whether specifically mentioned herein or not.

15.3.2 Tanks & other equipment

a) Two (2) – 3000 KL capacity vertical cylindrical heavy fuel oil storage tanks with accessories located in the oil tank dyke area. The HFO tanks shall be insulated.

b) One (1) – 1000 KL capacity vertical cylindrical High Speed Diesel oil storage tank with accessories located in the oil tank dyke area.

c) The heavy fuel oil storage tanks shall be complete with floor coil heaters and fuel oil suction heaters and other accessories as necessary.

d) One (1) oil water separator along with pumps as mentioned in this specification for the fuel oil unloading and storage area shall be provided with all needed accessories.

e) One (1) drain oil tank of 10 M^3 cap with 2 x 100% capacity pumpsets.

f) One (1) condensate tank of suitable capacity for main tank area.

g) Two (2) nos. drain oil pumps, each of capacity 5 M3/hr

h) Two (2) nos water pumps, each of capacity 30 M3/hr.

i) Two (2) Nos. sump pump set, each of capacity 30 M3/hr complete with all accessories of drive and mounting in FO Unloading pump house.

j) One (1) nos. pressure reducing and de-superheating station for reducing steam pressure to 4 kg/cm2.

15.3.2.1 Float type level indicators complete with accessories for each tank. All tanks should be calibrated and level indicator with scale shall be provided.

15.3.2.2 Adequately sized steel spiral staircases complete with grated stair treads, hand railing, etc for storage tanks for each tank.

15.3.2.3 Lot - Oil, water, and air pipe work materials including oil unloading heaters, pipe nozzles, stand pipes, fittings, flanges [including blind flanges as needed], bolts, nuts and gaskets for installation on tanks. This includes oil lines, valves, specialties, panels, accessories, thermal insulation materials etc as needed for satisfactory installation pipe work, valves etc.

15.3.2.4 Preparation of detailed fabrication & arrangement drawings.

15.3.2.5 The dead storage in the HSD storage tank should not exceed 30 KL.

15.3.2.6 The dead storage in the HFO storage tank should not exceed 100 KL.

15.3.2.7 Spare nozzles for suction and recirculation shall be provided in each HFO/ HSD tank for future use.

15.3.2.8 Lot - Pipe work materials, valves, specialties, motor operators, hangers & supports etc for -

- Connecting oil unloading headers upto oil pump sets; pumps discharge to oil tanks etc.

- Potable/ service water pipework to overhead rectangular tank and further distribution thereof.

- Providing adequately sized pipe nozzle connections on tanks for foam fire protection system.

- Service/instrument air pipe work inside the pump house and dyke area.

15.3.2.9 Heavy oil pipework, pumpsets, valves, strainers and storage tanks shall be provided with thermal insulation to prevent heat loss and safety of personnel. Thermal insulation shall be designed such that the skin temperature shall not more than 60^{o}C under all conditions.

15.3.2.10 The waste oil/drain oil collected from various points such as unloading points, drains, strainers, tank form area etc. shall be led to waste oil tank for further transferring to ETP.

15.4 EQUIPMENT DESCRIPTION

15.4.1 Pump Sets

15.4.1.1 The fuel oil pumps shall be rotary positive displacement self-priming horizontal type, twin screw with mechanical seals. The pumps shall be direct AC motor driven through flexible coupling without any gear box.

15.4.1.2 The pump construction shall incorporate two (2) inter-meshing screws ensuring pulsation free continuous axial flow; having their thread surfaces forming a tight seal to each other as well as the surrounding stator. When the screws rotate, the seals move axially forcing the liquid between them to move forward for smooth uniform pulsation free flow.

15.4.1.3 Suction and discharge connections shall be flanged raised faced and drilled to ASA standards or approved equal.

15.4.1.4 Heavy fuel oil pumps shall have stable head capacity characteristics continuously rising towards shut-off with the highest head at shut-off.

15.4.1.5 Approved type flexible couplings shall be provided for connecting the pumps with the driving motor. A common base plate with drain pan of drain rim type for pump & motor shall be in one piece in fabricated steel construction.

15.4.1.6 The pumpsets shall be electrically traced along with the associated suction and discharge pipework, valves and specialities to avoid solidification of oil and maintain continuous flow of fuel oil.

15.4.1.7 **Pumpset Motors**

Each pump shall be driven by direct coupled horizontal, 415 Volts, 3-phase, 50 hertz, AC squirrel cage, single speed, totally enclosed Explosion/Flame proof fan cooled construction induction motor to IS: 2148. The nameplate KW rating of the pump motor including service factor shall be at least 115 percent of the motor power

required to drive the pump at the duty operating point, or the maximum power consumed on the characteristic curve, whichever is higher.

15.4.1.8 **Accessories**

All accessories required for smooth and safe operation shall be provided along with pumpsets. Approved make pressure gauges shall be furnished having 150 mm dial with black figures on white dial or range 0 to 5 kg/cm^2(g); graduations 0.5 kg/cm^2; and inter-graduation 0.05 kg/cm^2(g), complete with isolating valves, piping and fittings as required. Approved make vacuum/pressure gauges on the pump suction side shall be provided similar to those on the discharge side having suitable range.

15.4.2 **Vertical Storage Tanks**

15.4.2.1 The vertical cylindrical oil storage non-pressure tanks shall be of mild steel to IS: 2062 Gr.B or approved equal welded construction designed, fabricated and installed in accordance with IS: 803. The tanks shall have sloping bottom 1 in 100 towards an adequately sized sump inside the tank to enable complete draining of the contents. Sufficient number of plugged holes shall be provided in the bottom plate of the tanks for bottom testing as per IS: 803.

Conical roof with a slope of not less than 1 in 16 to ensure drainage of rain water shall be provided supported over the tank wall periphery; and the tank shall have single central column. The roof shall be designed for a live load of 250 kg/m^2. Needed roof rafters and purlins shall be provided adequately designed.

15.4.2.2 All shell course plates shall be accurately bent at required radius. Care shall be taken during bending to prevent plate skewing. For butt-weld joints, edges shall be prepared which shall be uniform and smooth throughout.

Each shell course shall be of uniform height throughout longitudinal weld in any plate. Makeup for the course width shall not be permitted. Shell plates in each course width shall be so arranged that all vertical joints are staggered having a minimum of 600 mm stagger.

15.4.3 **Floor Coil Heater**

15.4.3.1 Each heavy fuel oil tank shall be provided with floor coil heater in one or more tiers at the bottom of the heavy fuel oil storage tanks to maintain oil within the tank at specified temperature with electricity as the heating medium. The tubes shall be seamless steel to A106 Gr. B supporting the coil within the tank bottom.

15.4.3.2 The floor heater shall be installed inside the tank such that oil is uniformly heated without possibility of local overheating and over-straining the tank body. All connection flanges shall be outside the tank. The coils shall be guaranteed to be submerged under sufficient level of oil to avoid flashing of oil.

15.4.4 **Fuel Oil Suction Heater**

15.4.4.1 The heavy fuel oil suction heater as per the duty conditions indicated below shall be furnished on the outlet of each fuel oil storage tank :

i) Type : Shell and U-tube type (to supply oil at pump suction)

ii)	Heating media	:	Electric
iii)	Initial temp of oil	:	50°C
iv)	Final temp of oil	:	70°C
v)	Oil temperature rise	:	20°C
vi)	Materials: - Shell; shell head; and tube sheet	:	Steel IS:2002 Gr. 2A
	- Tubes & nozzles	:	Seamless carbon steel to A106 Gr.B

15.4.4.2 The heater shall be designed as per applicable code. The heater shall be mounted on the side wall of the tank and properly supported. The heater shall have oil in the shell side and steam tracing in the tube side.

15.4.4.3 The bidder shall furnish the design calculations for

- arriving at electric tracing consumption, coil heat transfer area;
- maximum time required (72 hrs) to liquify the stored oil and bring it to the storing temperature under the extreme condition when the heating coil is turned on after prolonged shutdown with material stored in the tank, at the lowest ambient temperature.

15.4.5 **Tank Accessories**

Accessories for the tanks shall be furnished as necessary. All spare/unused flanged connections and manholes shall be provided with matching blind flanges, gaskets, bolts and nuts.

15.4.6 **Flame arrestor**: Each vent connection on oil tanks (HFO/HSD) shall be provided with a flame arrestor, design of which shall meet the approval of the Inspector of Explosives.

15.4.7 **Conservation vent valve**: Where continuous venting to atmosphere directly is not permitted for the stored fuel oil, a conservation vent valve or a breather of approved make and design shall be provided.

15.4.8 **Level Indicators & Level Switches**

The oil storage tanks shall be provided with flame proof float type level indicators & switches. The float type level indicators shall comprise of stainless steel enclosed float filled with approved light weight materials.

The flexible stainless steel wire attached to the float at one end and to the cast iron target at the other end shall freely roll on the bakelite pulley housed in a cast iron housing provided with bolted covers, as shown on the drawing.

The guide wire spring assembly shall be furnished complete with compression springs, pipe nipples and caps to provide required tension in the stainless steel wire connected to the float.

15.4.9 **Electricals and Control Instrumentation**

15.4.9.1 One (1) - Motor control centre/ switchgear; one lot of motor starters & push button stations for unloading pump sets with spare feeders including accessories for the heavy fuel oil pipework.

15.4.9.2 Power & control cabling with accessories for satisfactory installation of the facilities including needed interlocking facilities etc. All electrical equipments and instrumentation works including cables, cable laying, jointing, making connections from equipment to panels shall be furnished by the bidder. All the cables used shall be of FRLS type.

a) One (1) local control panel housing switches, annunciation, alarms, remote indicators etc as specified for the offered fuel oil handling facilities for control, operation and annunciation purpose of the offered plant shall be furnished. All control valves on electric and oil lines as considered necessary for safe and satisfactory operation of the system.

b) Lot - Local indicators such as pressure and temperature gauges, flow measuring indicators etc; level controlling equipment including level switches, level transmitters and other needed accessories not only for local control & indication but also for remote control operation & indication in the main plant control room [for hooking up with main plant DCS] and oil pump house control room.

c) All equipments shall be flame proof

15.4.9.3 Lightning protection; earthing; cathodic protection (as required); illumination of oil unloading pump house oil forwarding pumphouse & oil tank farm area; cable trays, conduits etc for satisfactory installation of the electrical system for the offered plant.

15.4.10 **Construction materials: Pipes, Valves & Hoses**

		Fuel Oil	**Steam/ Condensate**
15.4.10.1	Pipes - 65 mm NB & larger	API-5L Gr.B or A106 Gr.B BW ends ANSI B16.25	A106 Gr.B BW ends ANSI-B-16.25
	- 50 mm NB & below	A106 Gr.B Socket weld ends ANSI-B-16.11	-do-
15.4.10.2	Pipe fittings: - 65 mm NB & larger	A-234 or WPB BW ends ANSI-B-16.25	A-234 or WPB BW ends ANSI-B-16.25
	- 50 mm NB & below	A105 socket weld ends ANSI-B16.11	A105 socket weld ends ANSI-B16.11
15.4.10.3	Gate Valves	**←Fuel Oil/Steam/Condensate-→**	
		50 mm NB & large	Below 50 mm NB
	- Code	API-600	API-602
	- Body & bonnet	A-216 Gr. WCB	A 181 Gr. II

		Fuel Oil	**Steam/ Condensate**
	- Seat/trim	← 11 to 13% chrome steel -----→	
	- Bolts for bonnet	←---------- A 193 Gr. B7 ----------→	
	- Nuts for bonnet	←---------- A 194 Gr. 2H ----------→	
15.4.10.4	Globe valve		
	- Code	←----- BS-1873 ----------→	
	- Body & bonnet	A216 Gr. WCB	A 181 Gr.II
	- Trim	Chrome steel (Brinnel hardness B-250 min) as per AISI-431	
	- Bolts for bonnet	←----A 193 Gr. B7 ----------→	
	- Nuts for bonnet	←--- A 194 Gr. 2H ----------→	
15.4.10.5	Check valves:		
	- Code	←---------- BS-1868 ----------→	
	- Body & bonnet; Trim	←-Same as per globe valves above→	
	- Seating surfaces	←Same as per globe valves above →	
15.4.10.6	Ball valves:		
	- Code	BS-5351Teflon sealed full bore fire safe design	
	- Body	A216 Gr. WCB	A181 Gr. II
	- Ball	←Stainless Steel AISI-316------→	
15.4.10.7	Plug valves (oil service only)		
	- Code	API-599 self-lubricated wrench operated with an easy visible port position indicator	
	- Body	A216 Gr. WCB	A181 Gr.II
	- Plug	←Hardened carbon steel -------→	
15.4.10.8	Hoses:		
	- Oil service	Galvanised interlocked wire reinforced, type-S smooth bore with quick acting coupling fitting standard to suit road tanker/rail tanker.	

Oil Strainer: The strainers with flanged inlet and outlet connections shall have basket type straining elements permitting easy removal and replacement. The open area ratio (i.e. straining area to the inlet area ratio) shall be at least 10:1.

FUEL OIL UNLOADING SYSTEM

			HSD System	HFO System
1.0	a. Fuel Oil Transfer Pumps b. Pumps standard		Horizontal, Positive displacement, twin screw pumps VDMA/API 676	
1.1	Make		Approved vendor list subject to approval of Owner	
1.2	Quantity	Nr.	2 (1 W + 1 S)	3 (2 W + 1 S)
1.3	Capacity	TPH	50	100
1.4	Discharge Pressure	Bar	4.0	4.0
1.5	Speed (synchronous)	RPM	1500	1500
1.6	Material of construction Body Screws		 CI to IS 210 FG260 13 % Chrome steel	 CI to IS 210 FG 260 13 % Chrome steel
1.7	Accessories		Built in pressure relief valve	
			Pressure gauges	
			Coupling guards	
			Foundation bolts	
			Drip tray	
			FLP motors	
2.0	**Oil storage tanks**		Vertical, cylindrical, cone roof type as per IS:803	
2.1	Rated capacity	Kl	HSD-main: 1000	HFO main: 3000
2.2	Diameter	M	As per IS:803	
2.3	Height	M		
2.4	Material of construction		MS plate fabricated	
2.5	Accessories		Flame arrestor, float type level indicator, conservation vent valve, stand pipe with instruments	
2.6	Quantity of tanks	Nos.	1	2
3.0	Inter connecting piping, valves, specialties			
	Piping	For sizes 150mm NB and below	Oil: ERW CS pipes to IS:1239 with suitable fittings.	
			Aux. Steam and condensate: Seamless CS pipes to IS:1239 with suitable fittings	
	Valves	For sizes 65 mm NB and above	150 # Cast carbon steel flanged end ball, plug, gate, globe, check valves	

			HSD System	HFO System
		For sizes 50 mm NB and below	800 # Forged carbon steel socket welded end ball, plug, gate, globe, check valves	
	Strainers/Filters	At pumps suction	MS fabricated basket with SS screen mesh of less than 1mm openings	
	Insulation	For HFO and aux steam services	Mineral wool mattress type with 24 G Aluminium steel cladding	
4.0	Oil Storage Tank Farm dyke			
	Capacity		To contain one large tank contents.	
	Dyke wall		As per Statutory Guidelines – However min 2 m high RCC Wall above finished floor level + 1 m high barbed wire fencing over RCC wall.	

CHAPTER – 3

GENERAL TECHNICAL REQUIREMENTS

1.00.00 INTRODUCTION

This part covers technical requirements, which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical requirements brought out in the Technical Specifications and the Technical Data Sheets.

2.00.00 BRAND NAME

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Owner to determine that the products proposed are equivalent to those named.

3.00.00 BASE OFFER & ALTERNATE PROPOSALS

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Bidder may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice may also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Owner. Sufficient amount of information for justifying such proposals shall be furnished to Owner along with the bid to enable the Owner to determine the acceptability of these proposals.

4.00.00 COMPLETENESS OF FACILITIES

4.01.00 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is provided.

4.02.00 All equipment furnished by the Bidder shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation & maintenance of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All similar standard components/ parts of similar standard equipment provided, shall be interchangeable with one another.

5.00.00 CODES & STANDARDS

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following:

(a.) Bureau of Indian Standards (BIS)

(b.) Indian electricity act

(c.) Indian electricity rules

(d.) Indian Explosives Act

(e.) Indian Factories Act and State Factories Act

(f.) Indian Boiler Regulations (IBR)

(g.) Regulations of the Central Pollution Control Board, India

(h.) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

(i.) Pollution Control Regulations of Department of Environment, Government of India

(j.) State Pollution Control Board.

(k.) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(l.) Any other statutory codes / standards / regulations, as may be applicable.

5.02.00 Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

(a.) Japanese Industrial Standards (JIS)

(b.) American National Standards Institute (ANSI)

(c.) American Society of Testing and Materials (ASTM)

(d.) American Society of Mechanical Engineers (ASME)

(e.) American Petroleum Institute (API)

(f.) Standards of the Hydraulic Institute, U.S.A.

(g.) International Organisation for Standardization (ISO)

(h.) Tubular Exchanger Manufacturer's Association (TEMA)

(i.) American Welding Society (AWS)

(j.) National Electrical Manufacturers Association (NEMA)

(k.) National Fire Protection Association (NFPA)

(l.) International Electro-Technical Commission (IEC)

(m.) Expansion Joint Manufacturers Association (EJMA)

(n.) Heat Exchange Institute (HEI)

5.03.00 Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Owner's approval, for which the Bidder shall furnish, alongwith the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned else where in the specification together with the complete word to word translation of the standard that is normally not published in English.

5.04.00 As regards highly standardized equipment such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. In addition, these standards shall be referred for the design of machine foundations, wherever specifically mentioned in the specifications. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.

5.05.00 In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.

5.06.00 Two (2) English language copies of all-national and international codes and/or standards used in the design of the plant, equipment, civil and structural works shall be provided by the Bidder to the Owner within two calendar months from the date of the Notification of Award.

5.07.00 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Owner shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Bidder to bring to the notice of the Owner such changes and advise Owner of the resulting effect.

6.00.00 EQUIPMENT FUNCTIONAL GUARANTEE

6.01.00 The Equipment and Auxiliaries shall be capable of continuous operation in frequency range of 47.5 to 51.5 Hz.

6.02.00 The functional guarantees of the equipment under the scope of the Contract is given elsewhere in the technical specification. These guarantees shall supplement the general functional guarantee provisions covered under General Conditions of Contract.

6.03.00 Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Bidder as specified elsewhere in this specification.

7.00.00 DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Design of Facilities

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Bidder shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinate performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

7.02.00 Maintenance and Availability Considerations

Equipment/facilities offered shall be designed for high availability, low maintenance and ease of maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability/ availability and ease of maintenance. The Bidder shall also furnish details of availability records in the reference plants stated in his experience list.

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path and the minor and major overhauls shall be specified in terms of fired hours, clearly defining the spare parts and man-hour requirement for each stage.

Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the Bidder for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the Bidder for lifting the equipment and accessories covered under the specification.

8.00.00 DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY BIDDER

8.01.00 Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.

The Bidder shall furnish engineering data/drgs. in accordance with the schedule of information as specified in Technical Specification and data sheets.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in Annexure-I attached with Chapter 3.

8.03.00 The documentation that shall be provided by the Bidder is indicated in various sections of specification. The documentation shall include but not be limited to the following:

Basic Engineering Documentation

Prior to commencement of the detailed engineering work, the Bidder shall furnish a Plant Definition Manual within 4-6 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

i. System description of all the mechanical, electrical, control & instrumentation & civil systems.

ii. Technology scan for each system / sub-system & equipment.

iii. Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.

iv. Optimization studies including thermal cycle optimization.

v. Sizing criteria of all the systems, sub-systems including various piping systems/ equipment/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins.

vi. Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii. Operation Philosophy and the control philosophy of the Main Plant and other plants.

viii. General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Owner's scope. This drawing shall also be furnished in the form of floppy discs to the Owner for engineering of areas not included in Bidder's scope.

ix. Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area and other areas included in the scope of the Bidder.

x. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

xi. The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Owner.

xii. After approval of Plant Definition Manual / Design Basis Report, Bidder shall furnish detailed technical specification of all system / packages of the Plant.

i. Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

ii. Flow diagrams, Process & Instrumentation Diagrams alongwith write-up and system description.

iii. Start-up curves for turbine, boiler and both turbine and boiler combined together as a unit for various start-ups, viz. cold, warm and hot start-up.

iv. Piping isometric, composite layout and fabrication drawings.

v. Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.

vi. Technical data sheets for all bought out and manufactured items. Bidder shall use the specifications as a base for placement of orders on their sub-vendors.

vii. Detailed design calculations for components, system/sub-system,, piping etc., wherever applicable including sizing calculations for all auxiliaries as per criteria specified elsewhere in specification.

viii. Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier.

ix. Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.

x. Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser and heat exchanger thermal calculations etc.).

xi. Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.

xii. Comprehensive list of all terminal points which interface with Owner's facilities giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.

xiii. Power supply single line diagram, block logics, control schematics, electrical schematics, etc.

xiv. Protection system diagrams and relay settings.

xv. Interconnection diagrams.

xvi. Cable routing plan.

xvii. Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

xviii. Alarm and annunciation list and alarms & trip set points.

xix. Sequence and protection interlock schemes.

xx. Type test reports and power system stability study report.

xxi. Control system configuration diagrams and card circuit diagrams and maintenance details.

xxii. Detailed software manuals & source software listing.

xxiii. Detailed flow chart for digital control system.

xxiv. Mimic diagram layout.

xxv. Civil Task drawings(for the Engineering by Owner),Design and Drawings for the Civil & Structural works in the scope of the Bidder.

xxvi. Model study reports wherever applicable.

xxvii. Functional & guarantee test procedures and test reports.

xxviii. Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

xxix. Documentation in respect of commissioning as listed out elsewhere in this specification.

xxx. The Bidder while submitting the above documents / drawings for approval / reference as the case may be, shall mark on each copy of submission the reference letter alongwith the date vide which the submissions are made.

8.03.01 **Instruction Manuals**

The Bidder shall submit to the Owner, draft Instruction Manuals for all the equipment covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalization and approval of the Owner the Instruction Manuals shall be submitted as indicated in Annexure-I. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Owner. The Instruction Manuals shall comprise of the following.

Erection Manuals

The erection manuals shall be submitted atleast three (3) months prior to the commencement of erection activities of particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tool, tackles, heavy equipment like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection.

h) General safety procedures to followed during erection/installation.

i) Procedure for initial checking after erection.

j) Procedure for testing and acceptance norms.

k) Procedure / Check list for pre-commissioning activities.

l) Procedure / Check list for commissioning of the system.

m) Safety precautions to be followed in electrical supply distribution during erection

Operation & Maintenance Manuals

i. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant / equipment including, operation, maintenance, dismantling and repair including periodical activities such as chemical cleaning of the generator. Each manual shall also include a complete set of drawings together with performance/rating curves of the equipment and test certificates wherever applicable. The contract shall not be considered to be completed for purposes for taking over until these manuals have been supplied to the Owner.

ii. If after the commissioning and initial operation of the plant, the manuals require any modification / additions / changes, the same shall be incorporated and the updated final instruction manuals shall be submitted to the Owner for records.

iii. A separate section of the manual shall be for each size/ type of equipment and shall contain a detailed description of construction and operation, together with all relevant pamphlets and drawings.

iv. The manuals shall include the following :

a) List of spare parts along with their drawing and catalogues and procedure for ordering spares.

b) Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation.

c) Where applicable, fault location charts shall be included to facilitate finding the cause of maloperation or break down.

v. Detailed specifications for all the consumables including lubricant oils, greases, chemicals etc. system/equipment/assembly/sub-assembly - wise required for the complete plant.

vi. On completion of erection, a complete list of bearings / equipment giving their location, and identification marks etc. shall also be furnished to the Owner indicating lubrication method for each type/category of bearing.

8.03.02 **Plant Handbook**

The Bidder shall submit to the Owner a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipment and systems covering the complete project including

1. Design and performance data.
2. Process & Instrumentation diagrams.
3. Single line diagrams.
4. Sequence & Protection Interlock Schemes.
5. Alarm and trip values.
6. Performance Curves.
7. General layout plan and layout of main plant building and auxiliary buildings.
8. Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Owner's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03 **Project Completion Report**

The Bidder shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **Drawings**

(a.) All documents submitted by the Bidder for Owner's review shall be in electronic form (soft copies) along with the desired number of hard copies as per Annexure-I. The soft copies to be supplied shall be either in CDs, or through direct transfer via E-mail, etc. depending upon the nature/volume/size of the document. The drawings submitted for approval could be in the Image form.

(b.) Final copies of the approved drawings shall be submitted on CD-ROM along with the requisite number of hard copies as per Annexure-I.

(c.) The completed plant documentation with equipment drawings, data sheets, P&ID, BOQ, schematics, logic diagrams, test reports and quality plan, etc. shall be furnished to Owner.

(d.) All documents/text information shall be in latest version of MS Office.

(e.) All drawings submitted by the Bidder including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipment and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

(f.) Each drawing submitted by the Bidder (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Owner, Consultant, name of the Project, system designation, the specifications title, the specification number, drawing/document number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

(g.) The Bidder shall also furnish a “Master Drawing List” which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Owner. Such list should clearly indicate the purpose of submission of these drawings i.e. “FOR APPROVAL” or “FOR INFORMATION ONLY”.

(h.) Similarly, all the drawings/ documents submitted by the Bidder during detailed engineering stage shall be stamped “FOR APPROVAL” or “FOR INFORMATION” prior to submission.

(i.) The furnishing of detailed engineering data and drawings by the Bidder shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Owner will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipment provided by others and external connections & dimensions which might affect plant layout. The review by the Owner should not be construed to be a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or approval by the Owner / Project Manager shall not relieve the Bidder of any of his responsibilities and liabilities under this contract.

(j.) After the approval of the drawings, further work by the Bidder shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Owner.

(k.) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Bidder’s risk. The Bidder is expected not to make any changes in the design of the equipment /system, once they are approved by the Owner. However, if some changes are necessitated in the design of the equipment/system at a later date, the Bidder may do so, but such

changes shall promptly be brought to the notice of the Owner indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

(l.) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Owner prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/representative of Owner based on requirements of such piping indicated in approved / finalized Flow Scheme / Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

(m.) Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the Bidder well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

(n.) As Built Drawings

After final acceptance of individual equipment/system by the Owner, the Bidder will update all original drawings and documents for the equipment/ system to “as built” conditions.

(o.) Drawings must be checked by the Bidder in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Owner. In case drawings are found to be submitted without proper endorsement for checking by the Bidder, the same shall not be reviewed and returned to the Bidder for re-submission. The Bidder shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data/drawings at site which are needed as an input to the engineering. The Bidder shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Owner’s scope and submit all necessary drawings/ documents for the same.

(p.) The Bidder shall submit adequate prints of drawing/data/document for Owner’s review and approval. The Owner shall review the drawings and return one (1) copy to the Bidder authorizing either to proceed with manufacture or fabrication, or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Bidder to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

(q.) All engineering data submitted by the Bidder after final process including review and approval by the Owner shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Owner in writing.

8.04.00 **Engineering Information Submission Schedule**

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Owner. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts.

(a.) Information that shall be submitted for the approval of the Owner before proceeding further, and

(b.) Information that would be submitted for Owner's information only.

The Engineering Information Schedule shall be updated monthwise.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.05.00 **Engineering Progress and Exception Report**

8.05.01 Report giving the status of each engineering information including

(a.) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission

(b.) Drawings which were not submitted as per agreed schedule.

8.05.02 The draft format for this report shall be furnished to the Owner within four (4) weeks of the award of the contract, which shall then be discussed and finalized with the Owner.

8.06.00 **Co-Ordination Meetings**

8.06.01 The Bidder shall be called upon to organize and attend monthly Design/ Co-ordination Meetings with the Owner/Owner's representatives, Project Consultant during the period of contract. The Bidder shall attend such meetings at his own cost at mutually agreed venue as and when required and

fully co-operate with such persons and agencies involved during the discussions.

8.06.02 The Bidder should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Bidder shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Bidder will be reviewed by the Owner as far as practicable within three (3) weeks from the date of receipt of the drawing .The comments of the Owner shall then be discussed across the table during the above co-ordination Meetings wherein best efforts shall be made by both sides to ensure the approval of the drawing.

8.06.03 The Bidder shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Bidder shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.

8.06.04 Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.

8.06.05 Any delays arising out of failure by the Bidder to incorporate Owner's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Bidder to alter the Contract completion date.

8.07.00 **Design Improvements**

The Owner or the Bidder may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Bidder proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

8.08.00 **Equipment Bases**

A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Owner. Each base plate which support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.

8.09.00 **Protective Guards**

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

8.10.00 **Lubricants, Servo Fluids and Chemicals**

8.10.01 The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also be included in the scope of the Bidder. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.

8.10.02 As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible.

Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Owner along with lubrication requirements.

8.11.00 **Lubrication**

8.11.01 Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.

8.12.00 **Material of Construction**

8.12.01 All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilized for various components shall be those which have established themselves for use in such applications.

8.13.00 **Rating Plates, Name Plates & Labels**

8.13.01 Each main and auxiliary item of plant including instruments shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Owner.

8.13.02 Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Owner or as detailed in appropriate section of the technical specifications.

8.13.03 Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering

engraved on the back. The name plates shall be suitably fixed on both front and rear sides.

8.13.04 Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with epoxy. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.

8.13.05 Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support. Suitable scale shall also be provided to indicate load on support/hanger.

8.13.06 Valves, steam traps and strainers shall be identified by Owner's tag number of a metal tap permanently attached to non pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.

8.13.07 Safety and relief valves shall be provided with the following :

(a.) Manufacturer's identification.

(b.) Nominal inlet and outlet sizes in mm.

(c.) Set pressure in Kg/cm2 (abs).

(d.) Blowdown and accumulation as percentage of set pressure.

(e.) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.

8.13.08 All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

8.13.09 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system

8.14.00 **Tools and Tackles**

The Bidder shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Bidder shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Bidder should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Owner.

8.15.00 **Welding**

8.15.01 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipment to be per formed by others the requirements shall be submitted to the Owner in advance of commencement of erection work.

8.16.00 **Colour Code for all Equipment/ Pipings/ Pipe Services**

8.16.01 All equipment/ piping/ pipe services are to be painted by the Bidder in accordance with Owner's standard colour coding scheme, which will be furnished to the Bidder during detailed engineering stage.

8.17.00 **Protection and Preservative Shop Coating**

8.17.01 **Protection**

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a nonmetallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or overground environment as the case may be.

8.17.02 **Preservative Shop Coating**

All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted with atleast two coats of primer.

Transformers and other electrical equipment if included shall be shop finished with one or more coats of primer and two coats of high grade epoxy. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Owner at a later date.

8.17.03 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Bidder after obtaining specific approval of the Owner regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Owner.

8.17.04 All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Owner.

8.17.05 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Owner. Lube oil piping or carbon steel shall be pickled.

8.17.06 Painting for Civil structures shall be done as per relevant part of technical specification.

9.00.00 QUALITY ASSURANCE PROGRAMME

9.01.00 The Bidder shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Bidder's works or at his sub-Bidder's premises or at the Owner's site or at any other place of work are in accordance with the specifications. Such programs shall be outlined by the Bidder and shall be finally accepted by the Owner/authorized representative after discussions before the award of the contract. The QA programme shall be generally in line with IS/ISO-9001. A quality assurance programme of the Bidder shall generally cover the following:

(a.) His organization structure for the management and implementation of the proposed quality assurance programme

(b.) Quality System Manual
(c.) Design Control System

(d.) Documentation and Data Control System

(e.) Qualification data for bidder's key personnel.

(f.) The procedure for purchase of materials, parts, components and selection of sub-Bidder's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.

(g.) System for shop manufacturing and site erection controls including process, fabrication and assembly.

(h.) Control of non-conforming items and system for corrective actions and resolution of deviations.

(i.) Inspection and test procedure both for manufacture and field activities.

(j.) Control of calibration and testing of measuring testing equipment.

(k.) System for Quality Audits.

(l.) System for identification and appraisal of inspection status.

(m.) System for authorising release of manufactured product to the Owner.

(n.) System for handling, storage and delivery.

(o.) System for maintenance of records, and

(p.) Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

9.02.00 **General Requirements - Quality Assurance**

9.02.01 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is, however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme duly approved by the Owner. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Owner for approval. Schedule of finalisation of such quality plans will be finalised before award. Monthly progress reports on MQP/FQP submission/approval shall be furnished.

9.02.02 Manufacturing Quality Plan will detail out for all the components and equipment, 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/ Sub-Bidder's/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. Compact Disc or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.

9.02.03 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.

9.02.04 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference

documents/standards etc. will be subject to Owner's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Owner shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Owner's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Owner in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner along with technical justification for approval and dispositioning.

9.02.05 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Owner's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).

9.02.06 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure 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.

9.02.07 The Bidder shall submit to the Owner Field Welding Schedule for field welding activities in the enclosed format No.: QS-01-QAI-P-02/F3. The field welding schedule shall be submitted to the Owner along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.

9.02.08 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All welding/brazing procedures shall be submitted to the Owner or its authorised representative for approval prior to carrying out the welding/brazing.

9.02.09 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/sub-Bidder's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Owner.

9.02.10 Welding procedure qualification & Welder qualification test results shall be furnished to the Owner for approval. However, where required by the Owner, tests shall be conducted in presence of Owner/authorised representative.

9.02.11 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the

equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding.

9.02.12 Unless otherwise proven and specifically agreed with the Owner, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

9.02.13 No welding shall be carried out on cast iron components for repair.

9.02.14 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

9.02.15 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.

9.02.16 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors bought out items (BOI). All the sub-Bidder proposed by the Bidder for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Bidder and finalised with the Owner, shall be subject to Owner's approval. The Bidder's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Owner for approval within the period agreed at the time of pre-awards discussion and identified in review category prior to any procurement. Monthly progress reports on sub-Bidder detail submission / approval shall be furnished. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.

9.02.17 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Owner, the Bidder's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-Bidder shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Owner and such approved Quality Plans shall form a part of the purchase order/contract between the Bidder and sub-Bidder. With in three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications,

quality plans and delivery conditions shall be furnished to the Owner on the monthly basis by the Bidder along with a report of the Purchase Order placed so far for the contract.

9.02.18 Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their sub-Bidder's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

9.02.19 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-Bidder's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Bidder shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

9.02.20 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Owner to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

9.02.21 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

9.02.22 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Owner/ authorised representative.

9.02.23 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment

All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from manufacturing works, as per the following cycle.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and

inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case the Bidder/ sub-Bidder is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Bidder/ sub- Bidder along with the statistical figures to validate the alternate procedure to be forwarded.

The Bidder/Sub-Bidder shall carry out routine test on 100% item at Bidder/sub-Bidder's works. The quantum of check/test for routine & acceptance test by Owner shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

9.03.00 **QA Documentation Package**

The Bidder shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (?) mark.

9.03.01 Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub- supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However CD-Rom may be issued not later than three weeks.

9.03.02 Typical contents of QA Documentation is as below:-

(a.) Quality Plan

(b.) Material mill test reports on components as specified by the specification and approved Quality Plans.

(c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

(d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

(e.) Heat Treatment Certificate/Record (Time- temperature Chart)

(f.) All the accepted Non-conformance Reports (Major/Minor) / deviation, including complete technical details / repair procedure).

(g.) CHP / Inspection reports duly signed by the Inspector of the Owner and Bidder for the agreed Customer Hold Points.

(h.) Certificate of Conformance (COC) wherever applicable.

(i.) MDCC

9.03.03 Similarly, the Bidder shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

9.03.04 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

(c.) If a decision is made despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time. The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of

QA documentation package shall not be later than 3 weeks after the despatch of equipment.

9.03.05 Transmission Of QA Documentation

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Owner.

For the particular case of phased deliveries, the complete quality document to the Owner shall be issued not later than 3 weeks after the date of the last delivery of equipment.

9.04.00 **Project Manager's Supervision**

9.04.01 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section General Conditions of Contract, the Bidder shall proceed to comply with the Project Manager's decision.

9.04.02 The work shall be performed under the supervision of the Project Manager. The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

(a.) Interpretation of all the terms and conditions of these documents and specifications:

(b.) Review and interpretation of all the Bidder's drawing, engineering data, etc:

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract :

(d.) Inspect, accept or reject any equipment, material and work under the contract.

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

9.05.00 **Inspection, Testing And Inspection Certificates**

9.05.01 The word 'Inspector' shall mean the Project Manager and/or his authorized representative and/or an outside inspection agency acting on behalf of the

Owner to inspect and examine the materials and workmanship of the works during its manufacture or erection.

9.05.02 The Project Manager or his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Bidder shall obtain for the Project Manager and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.

9.05.03 The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the Bidder may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

9.05.04 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Bidder shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

9.05.05 When the factory tests have been completed at the Bidder's or sub-Bidder's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.

9.05.06 In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-Bidder, the Bidder, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorized representatives to carry out effectively such tests on the equipment in accordance with the Bidder and shall give facilities to the Project Manager/Inspector or to his authorized representative to accomplish testing.

9.05.07 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed Quality Assurance Programme forming a part of the contract.

9.05.08 To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03- of this chapter, the Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

9.05.09 All inspection, measuring and test equipment used by Bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.

9.06.00 **Associated document for quality assurance programme:**

9.06.01 List of items requiring quality plan and sub supplier approval. (Annexure-III).

9.06.02 Status of items requiring Quality Plan and sub supplier approval. (Annexure-IV).

9.06.03 Field Welding Schedule (Annexure-V).

9.06.04 Manufacturing Quality Plan (Annexure-VI).

9.06.05 Field Quality Plan (Annexure-VII).

10.00.00 PRE-COMMISSIONING AND COMMISSIONING FACILITIES

(a.) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Owner and the Bidder for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Bidder's quality assurance programme as well as those included elsewhere in the Technical Specifications.

(b.) The Bidder's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall

be commenced during which period the complete facilities, equipment shall be operated integral with sub-systems and supporting equipment as a complete plant.

It will be the responsibility of the Bidder to assess and furnish a list of all commissioning spares required for successful commissioning of all the equipment covered under the contract. Such a list shall be furnished by the Bidder within 12 months from the date of LOA, separately for each equipment and shall be reviewed by the Owner and discussed for mutual agreement. The commissioning spares will be so identified as not to allow the trial operation to suffer for want of such commissioning spares. The identification of commissioning spares will not in any way relieve the Bidder of any of his responsibilities of satisfactory performance under the provisions of other conditions of contract. All the commissioning spares shall be deemed to be included in scope of the Bidder as a part of the respective equipment package at no extra cost to the Owner.

(c.) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Owner six months prior to the respective implementations. The Owner will approve final verification of cleanliness.

(d.) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

(e.) The check outs during the pre - commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Owner's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] approved by the Owner.

(f.) The Bidder during initial operation and performance testing shall conduct vibration testing to determine the ‘base line’ of performance of all plant rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

(g.) Bidder shall furnish the commissioning organization chart for review & acceptance of Owner at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain :

(1.) Biodata including experience of the Commissioning Engineers.

(2.) Role and responsibilities of the Commissioning Organisation members.

(3.) Expected duration of posting of the above Commissioning Engineers at site.

10.02.00 **Initial Operation**

a) On completion of all pre-commissioning activities / tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours.

c) The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performacne of the equipment/ facility.

d) The Bidder shall intimate the Owner about the commencement of initial operation and shall furnish adequate notice to the Owner in this respect.

e) Any loss of generation due to constraints attributable to the Owner shall be construed as Deemed Generation.

f) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Bidder. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Bidder to the full satisfaction of the Owner to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the equipment, shall not be considered as reasons for with holding the aforesaid permission.

10.03.00 **Guarantee Tests**

a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Bidder in presence of the Owner. The Bidder's Commissioning, Start-up Purchaser shall make the unit ready to conduct such test. Such test will be commenced and completed as per schedule indicated in Vol I GCC

b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.

c) For performance/ demonstration tests instrumentations, of accuracy class, to the approval of the Owner shall be used. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Owner's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.

d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Bidder, free of cost.

e) The Guarantee tests and specific tests to be conducted on equipment have been brought out in detail elsewhere in the specification.

11.00.00 TAKING OVER

Upon successful completion of Initial Operations and all the tests other than guarantee tests conducted to the Owner's satisfaction, the Owner shall issue to the Bidder a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be with held nor will the Owner delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Bidder of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

12.00.00 TRAINING OF OWNER'S PERSONNEL

12.01.00 The scope of service under training of Owner shall include a training module in the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Owner:

(a.) Training for Steam Generator Equipment

(b.) Training for TG and related equipment.

(c.) DDCMIS

(d.) Training for Electric Power Supply systems

(e.) Training for HT motor

(f.) Training for power cycle piping/critical piping.

The above training shall be provided taken by the EPC Bidder in one of the reference power plant.

12.02.00 The scope of services under training shall also necessarily include training of Owner's Engineering personnel covering a training module of upto 52 man months. This shall cover all disciplines viz, Mechanical, Electrical, C&I, & QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design softwares of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing, erection, welding etc. An indicative module of the training requirement of Owner's Engineering personnel is attached as Annexure-II.

Four (4) man month and two (2) man month training for Purchasers Engineering Personnel on the offered CFD modelling code for SG & ESP including alternative geometry modelling technique to be provided.

12.03.00 Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Owner's approval. Consolidated training period included above (i.e. 35 and 52 man months respectively for O&M and Engineering) is indicative only. Owner reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.

12.04.00 Clause 12.02.00 & 12.03.00 shall be applicable for domestic bidders. For foreign bidders refer Vol I GCC.

12.05.00 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.

12.06.00 In all the above cases, wherever the training of Owner's personnel is arranged at the works of the manufacturer's it shall be noted that the lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.

12.07.00 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Owner reserves the right to include or exclude these item(s) during place of Award. All expenses except travelling expenses shall be borne by the contractor.

13.00.00 SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

(a.) Working platforms should be fenced and shall have means of access.

(b.) Ladders in accordance with Owner’s safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

14.00.00 NOISE LEVEL

The equivalent 'A' weighted sound pressure level measured at a height of 1.0 m above floor level in elevation and at a distance of one (1) meter horizontally from the nearest surface of any equipment / machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for

(a.) Safety valves and associated vent pipes for which it shall not exceed 105 dBA.

(b.) Regulating drain valves in which case it shall be limited to 90 dBA.

(c.) TG unit in which case it shall not exceed 90 dBA.

(d.) For HP-LP bypass valves and other intermittantly operating control valves, the noise level shall be within the limit of 85 dBA.

15.00.00 PACKAGING AND TRANSPORTATION

All the equipment & spares shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. Each spare shall be clearly marked or labeled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer.In case of equipment supplied with grease/lubricants from imported origin, the supplied shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Owner to procure these items from indigenous sources. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting dispatch of equipment. Before dispatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & pre-assembly to bare minimum. The Owner's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.

16.00.00 ELECTRICAL ENCLOSURE

All electrical equipment and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification.

17.00.00 INSTRUMENTATION AND CONTROL

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.

17.01.00 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

a)	Temperature	-	Degree centigrade (deg C)
b)	Pressure	-	Kilograms per square centimeter (Kg/cm^2). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
c)	Draught	-	Millimeters of water column (mm wc).
d)	Vacuum	-	Millimeters of mercury column (mm Hg) or water column (mm Wcl).
e)	Flow (Gas)	-	Tonnes/ hour
f)	Flow (Steam)	-	Tonnes/ hour
g)	Flow (Liquid)	-	Tonnes / hour
h)	Flow base	-	760 mm Hg. 15 deg.C
i)	Density		Grams per cubic centimeter.

17.02.00 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

17.03.00 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalized & components shall be of industrial grade or better.

18.00.00 ELECTRICAL NOISE CONTROL

The equipment furnished by the Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Bidder's equipment, which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-801- 2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems.

19.00.00 INSTRUMENT AIR SYSTEM

The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power cylinders, E/P converters, piping / tubing etc. shall be as per the details furnished elsewhere.

Each pneumatic instrument shall have an individual air shut - off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

20.00.00 TAPPING POINTS FOR MEASUREMENTS

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Bidder will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Bidder.

(a.) Temperature test pockets with stub and thermowell

(b.) Pressure test pockets

21.00.00 ELECTRONIC MODULE/COMPONENT DETAILS

The Bidder shall have to furnish all technical details including circuit diagrams, specifications of components, etc., in respect of each and every electronic card/module as employed on the various solid state as well as microprocessor based systems and equipment including conventional instruments, peripherals etc.

It is mandatory for the Bidder to identify clearly the custom built ICs used in the package. The Bidder shall also furnish the details of any equivalents of the same.

22.00.00 ENVIRONMENTAL MONITORING & CONTROL MEASURES

Bidder to note that MOEF has declared Manali area as critically polluted area and also imposed certain restrictions on consideration of developmental projects.

Concerned authorities have been addressed to have self monitoring system (for Air, Water & Land) so as to ascertain the level of compliance of standards prescribed by MOEF and also to furnish the action plan ie., for the establishment of self monitoring system. It is also directed to undertake Environmental Audit (EA) to ascertain the compliance level of standards notified by MOEF.

In this context it is to be noted that our proposed project is also located in the said critically polluted cluster. Though environmental clearance for the said project has been obtained the Controlling Authorities will be highly keen and keep a tight vigil on the availability/provision of self monitoring system (for Air, Water & Land) so as to ascertain the level of compliance of standards prescribed by MOEF.

Environmental Clearance:

The environmental appraisal minutes are indicated below.

"Expert Appraisal Committee/MoEF has considered the project on 25th June 2012 and recommended issue of EC subject to TANGEDCO furnishing the cumulative impact on air, water and soil considering the Industries located 15km radius from the Ennore SEZ Project Site. The same is being furnished. Copy of Minutes of EAC is enclosed. Final Environmental Clearance yet to be received. For Compliance of conditions stipulated by TNPCB under section 21 of the Air (Prevention and control of Pollution) Act 1981 as amended in 1987, the following are included in the specification:

a) RCC chimney with designed height of 275mtrs included in the specification.
b) High efficiency ESPs (99.9% efficiency) have been proposed to ensure emission of particulate matter within 50 mg/$Nm^{3.}$.
c) Bag filters have been proposed for the coal crushers to collect suspended particulate emission.
d) Dust suppression system has been proposed for the coal yard.
e) Equipment for continuous monitoring of Ambient Air Quality has been proposed.
f) On line / automatic continuous stack monitor has been proposed.
g) Port holes in the chimney and sampling facilities for the stack for the proposed Boiler, as per the Central Pollution Control Board guide lines.
h) The unit shall have suitable sufficient acoustic measures for Generator, Turbine, Coal crusher and other sources including special anti vibration Foundation for which all the heavy rotating equipments / machines shall be erected over the Anti vibration foundations to reduce noise, vibration etc.,
i) The unit shall have separate energy meter for the operation of the Electro Static Precipitator, the Air pollution control equipment for the proposed Boiler.

j) Alternate power source will come into effect in case of power failure for the operation of Air Pollution Control measures

k) laboratory for analysis of gaseous / particulate emissions

l) The coal shall be stored in a completely paved area with the provisions for leach ate collection. The coal storage yard shall be provided with wind barriers of sufficient height. The height of the coal piles shall be lower than that of the wind barrier.

m) The location of wind barriers shall be based on the predominant wind direction and shall be in consultation with TNPCB so as to avoid fugitive dust emission.

n) Closed conveyors for coal transport and Bag filters in all the transfer points to control dust emission have been proposed

o) Dust suppression system / water sprinklers to keep the stock pile sufficiently wet all the time to avoid carryover of dust.

p) All the internal roads shall be well paved and be provided with water sprinkling arrangement to avoid fugitive dust emission during vehicle movement. The unit shall limit the speed of the vehicle to 10KM/hr. for heavy vehicles within the plant premises to prevent the road dust emission.

q) Burners have been designed for low NOx.

r) Space provision made for installation of FGD of requisite efficiency of removal of SO2, if required at a later stage for which adequate space is provided near the chimney.

s) The unit shall ensure that the velocity of the exit gas from the stack shall be greater than 25 m/sec and the ratio of the exit gas to wind velocity shall not be less than 1.5 to eliminate or reduce pollutant down wash.

t) The unit shall have on line/automatic continuous stack monitors with computer recording arrangement for monitoring SPM, Sox and Nox in the boiler emission.

u) Sewage Treatment Plant & Effluent Treatment Plant has been proposed.

v) Natural draft cooling tower has been included in the specification.

w) 100% Dry fly ash collection system and conventional wet bottom ash disposal is included. However ash water recovery system is included in this scope if ash slurry is disposed in the ash pond in emergencies.

x) Ash slurry pipe lines and ash water recovery pipe lines of adequate capacity and strength are proposed to be provided. However these pipe lines will be used only during emergency, since 100% dry fly ash collection is proposed.

Hence, it is stated that the implementation of Environmental measures including self monitoring system (for air, Water and land) as per the EC granted, especially in the following areas have to be ensured by the bidder without any exception:

Continuous Air quality monitoring stations
Online monitoring system
Effluent Treatment plant
Sewage treatment plant
Optimum use of land area
100% Ash collection & utilisation
Green Belt Development.

ANNEXURE-I

S. NO.	DESCRIPTION OF MANUALS	NO OF PRINTS (sets)	NO. OF CD-ROMs (sets)
1.	PLANT DEFINITION MANUAL-	-	3 CD-ROMs
2.	Drawings "FOR APPROVAL"	10	Soft Copy
3.	Drawings "FOR INFORMATION"	10	Soft Copy
4.	Drawings "FINAL APPROVED DRAWING"	8	Soft Copy
5.	Drawings "AS BUILT "	8	3 CD-ROMs
6	DATASHEETS,DESIGNCALCULATIONS,PURCHASE SPECIFICATIONS, etc. and Other type of documents		
	i) For Approval	10	SOFT COPY
	ii) FINAL	8	3 CD-ROMs -
	iii) Analysis reports of equipment/ piping/ structures components/ systems employing software packages as detailed		
	in the specifications		
	a) Input	10	SOFT COPY
	b) Output	10	SOFT COPY
	c) Drawings/ Sketches	10	SOFT COPY
7	Erection manual "FINAL"	8	3CD ROMS
8	Operation & Maintenance manual	10	3CD ROMS
9	Plant Hand Book "DRAFT"	6	SOFT COPY
10	Plant Hand Book "FINAL"	15	3CD ROMS
11	Commissioning and Performance Procedure manual	10	3CD ROMS
12	Performance and Functional Guarantees test report	6	3CD ROMS
13	Progress Reports	6	3CD ROMS
14	Project completion report	10	3CD ROMS
15	QA programme including	1	

S. NO.	DESCRIPTION OF MANUALS	NO OF PRINTS (sets)	NO. OF CD-ROMs (sets)
	Organization for implementation and QA system manual (with revision-servicing)		
16	Vendor details in respect of proposed vendors including Bidder's evaluation report.	1	
17	Manufacturing QPs, Field QPs, Field welding schedules and their reference documents like test procedures, WPS, POR etc.		
	(i) For review/comment	3	
	(ii) For final approval	4	1 set CD ROMS
18	Welding Manual, Heat Treatment Manuals,	4	
	Storage & preservation manuals		
	Final	4	2 CD ROMS
19	Monthly Vendor Approval	2	1 CD ROM
	and QP approval status		
20	QA Documentation Package for items / equipment manufactured and dispatched to site	2	2 CD ROMS
21	QA Documentation Package for field activities on equipment/systems at site	2	2 CD ROMS

ANNEXURE-II

(Total within 52 man months)

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
STEAM GENERATOR	Thermal design and hydraulic circulation balance	Familiarization with various system and equipment	Manufacturing processes of pressure parts, and equipment	Control philosphy operation, notices, logic & protection schemes, O&M manual familiarization O&M issues
	Combustion and Air & gas weight calculation	Performance data collect-ion analysis and review	Welding process	
	Pressure part calculation	O&M feed back	Testing facilities	Familiarization of special maintenance techniques.
	Pressure part and strength calculation	Operation history of various equipment and system	Product development in process	Special tool and tackles familiarization
	Tube metal temp. calculation and selection.	Failure analysis	Future plan for technology induction	
	Performance calculation		R&D work inprogress	
	Duct design.			
	Pressure part			

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design Equipment and system sizing and selection of mills, fans, airpreheater, soot blowers, dampers, valves heater, soot blowers, dampers, valves, feeders, burners startup system, fuel firing system, draft plant Flow scheme develop- ment of air & flue gas, fuel oil, auxiliary steam, main and reheat steam feed water.	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
	Layout of over all plant, steam generator area, pressure part arrangements, platforms, equipment, piping and duct, coal pipe, flue gas ducts, bunker arrangement, valves and damper, ESP area, cable & piping tressels etc.			
	Erection stretegies, erection procedures			
	Performance and demonstration tests.			
MANDAYS	**120**	**20**	**20**	**20**
CFD model development and validation for Steam Generator	Familarisation of fundamentals and basis for the development of the CFD models.			
	Solving of set of simple problems by Em- ployer's engineers with the help of trainer.			

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
	Hands on experience on the development of detailed/realistic CFD models for the steam generator and ESP. The Bidder/trainer shall develop CFD models for SG & ESPas per the Contract requirement with complete association of the Owner's engineers.			
	Validation of the above CFD model for SG & ESPby Bidder in association with the Owner's Engineers.			
MANDAYS	**120 for SG and 60 for ESP**	**-**	**-**	**-**

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
TURBINE GENERATOR AND IT'S INTEGRAL AUXILIARIES	Turbine cycle optimization and turbine performance in off design condition.	Familiarization of power plants of various makes of turbines for super critical units	Manufacturing processes of turbine	
	Rotor design and strength calculation	Collection of data for analysis of availability of turbines	Assembly of turbine	
	Rotor dynamic behavior studies wrt natural frequency, critical speed, vibration etc.	Comparative studies for integral systems of turbine	Testing of turbines	
	Blade profile/root design and blade strength design, blade vibration analysis	O&M history/problems related to turbine	Product development in process	
	Casing & diaphragm design	Failure analysis	Future plan for technology induction	
	Labyrinth seal selection & design for different turbine configurations		R&D work in progress	
	Selection of turbine type (i.e. Tandem vs cross compounding, separate HP/IP vs combined HP/IP, material of construction etc.)			

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
	Design principle for Up rating/down rating of existing design/ modules for the specific project.			
	Selection of nos., type and arrangement of bearings, load calculation on bearings, bearing oil flow calculation Selection, design and control principle for Turbine governing system Performance calculation Steam path audit Layout principle of various equipment's of TG and its integral system Latest technological advancements			
MANDAYS	**45**	**10**	**10**	
Boiler Feed Pumps	Techno-economic syudies for Selection of BFP Configuration and its drive Criteria for selection of boiler	Familiarization of power plants of various makes of feed pumps Data collection of BFP	Manufacturing process of various components of BFP Assembly of BFP	

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
	Feed Pump parameters	parameters and configur ation		
	Rotor design, strength calculation and rotor dynamic behavior studies wrt critical speed, vibration etc	Collection of data for analysis of availability of BFP	Testing, capabilities of BFP at works wrt performance, NPSH, thermal shock, dry run, visual cavitation, string test, axial thrust measurement	
	Impeller design and its hydraulic behavior	O&M history/problems related to BFP	Product development in process	
	Role of critical para- meters such as NPSH(R), Suction specific speed, running clearances, speed etc. in design of feed pumps	Comparative studies for various types of BFP& its features	Future plan for technology induction	
	Material selection of BFP components		R&D work in progress	
	Guiding factors for selection of BFP seals			
	Computation of axial thrust under various flows			
	Performance calculation			
	Transient analysis in pump			

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
	suction piping wrt NPSH margin Latest technological trends in BFP design			
MANDAYS	**20**	**5**	**10**	
Condenser	Selection of condenser type and its optimization wrt temp rise across condenser, pressure drop in condenser, surface area etc.	Comparative studies of salient features	Manufacturing process of various components of condenser Assembly	
	Techno economic studies for Selection of condenser tube material and other parts depending on water quality	Collection of data for analysis of availability of Condenser	Testing capability at works	
	Condenser support selection & design	O&M history/problems related to condenser	Product development in process	
	Sizing of condenser w.r.t. super critical units		Future plan for technology induction	
	Latest technological trends in condenser arrangement and design		R&D work in progress	
	Condenser vacuum system design			

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
MANDAYS	**10**	**5**	**5**	
Feed Regenerative Equipment's	Thermal and mechanical design calculation of heaters Basis of selecting horizontal/vertical heaters Selection of TTD and DCAs for various heaters, and their effect on turbine heat rate Configuration of HP heaters (2x50% v/s100% capacity	Comparative studies of salient features Analysis of data O&M history/problems related to heaters	Manufacturing process of various components of heaters Assembly Testing capability at works Product development in process	
	Sizing criteria for De-aerator/Heaters Selection of tube & tube sheet material of heaters Latest technological trends in heaters design		Future plan for technology induction R&D work in progress	
MANDAYS	**15**	**10**	**10**	
3-dimensional CFD modeling	CFD model develop ment and validation of design data for steam turbine, BFP, CEP, condenser, heaters etc.			

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
MANDAYS	20			
Compressors	Equipment Theory & Maintenance Practice			
MANDAYS	16	-----	4	
Ash Handling System	Equipment Theory & Maintenance Practice			
MANDAYS	16	4	4	
Coal Handling System	Equipment Theory & Maintenance Practice			
MANDAYS	20	5	5	
H_2 Plant	Equipment Theory & Maintenance Practice			
MANDAYS	10	3	3	
Condensate Polishing Unit	Equipment Theory & Maintenance Practice			
MANDAYS	15	5	5	

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
CONTROL & INSTRUMENTATION				
DDCMIS-Man Machine Interface - Hardware & Operating System	Hardware & Software organization of the system Basis of selection of H/W memory sizing Operating system features, interface with other system, openness & inter- operability Upgradability System testing features	Operational feedback		
MANDAYS	**24**	**6**		16
DDCMIS-Man Machine Interface System Engineering & Application Software	Specific system customisation	Operation feedback		
	Various system			
	modules & interface with OS			
	Database organization & development			
	Development of mimics			
	Other application like calculations, logs historical storage functionalities & use			
MANDAYS	**40**	**6**		8

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
DDCMIS - Control System Hardware	Basic design features for system & its modules System capabilities & system design techniques Communication with MMI & other system	Operation feedback	Manufacturing processes special attention to handling of the modules Maintenance facilities	
MANDAYS	**24**	**5**	**10**	
DDCMIS-Control system Application Software	Database structure Organisation & inter- face between application program & database	Operational feedback	System integration & System capabilities testing	
	Application for implementation of Control functions			
	Study of standard algorithms & development of new algorithms			
MANDAYS	**18**	**4**	**4**	
DDCMIS - Control Loop Study Loop Study	General description of closed loop controls of thermal power plant	Specific operational feedback		
	Critical analysis of few control loops e.g., TSCS Stress Control boiler startup control etc.			

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
MANDAYS	**12**	**4**		
DDCMIS-Burner Management System	Hardware logic, NFPA/ VDE requirements other safety standard Flame scanner location	Operational feedback	Manufacturing procedure& precautions for handling the system System testing facilities	
MANDAYS	**16**	**6**	**6**	**12**
DDCMIS - EHTC, Turbine stress control system, Turbine protection system& ATRS	Basic design concept& features Logics of turbine stress control system Implementation of failsafe philosophy in turbine protection system	Operational feedback	Manufacturing procedure & precautions for handling for handling the system System testing facilities	
MANDAYS	**16**	**6**	**6**	**12**
Furnace and Flame Viewing System.	Theory & principle of operation Details of software & methods of modification/ customisation	Operational feedback		
Misc. systems for SG/TG C&I				

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
MANDAYS	**6**	**3**		
BOP (DDCMIS)	Hardware organization		Manufacturing process of PLC hardware	
	Operating system features		Integration & testing facilities	
	Data base organization			
	Logic/loop algorithm Development of control logic & loop s/w & MMI application development			
MANDAYS	**24**	**-**	**6**	
BOP Controller System				
1) Hard Ware	**Equipment Theory & Maintenance Practice**			
MANDAYS	**30**	**10**	**10**	
2) Soft Ware	**Equipment Theory & Maintenance Practice**			
MANDAYS	**30**	**10**	**10**	
VMS				
1) Hardware	**Equipment Theory &**			

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
	Maintenance Practice			
MANDAYS	12	-	6	
2)Vibration Analysis	Equipment Theory & Maintenance Practice			
MANDAYS	12	-	6	
Analyser				
Water & Gas	Equipment Theory & Maintenance Practice			
MANDAYS	20	-	8	
PADO: System Engineering	Equipment Theory & Maintenance Practice			
MANDAYS	6	3	3	
PADO: Operation & Analysis	Equipment Theory & Maintenance Practice			
MANDAYS	18	6	-	
Actuators	Equipment Theory & Maintenance Practice			
MANDAYS	18	-	6	
Simulator	Equipment Theory &			

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
	Maintenance Practice			
MANDAYS	**16**	**-**	**4**	
Networking / MIS	**Equipment Theory & Maintenance Practice**			
MANDAYS	**12**	**-**	**4**	
Electric Power Supply System	Theory & design features		Manufacturing/assembly process	
			Testing methodology	
MANDAYS	**5**	**2**		

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
(ELECTRICAL) GENERATOR	(a) Design aspects of the following areas	- Operational feed back	(a) Manufacturing process for	
	- Insulation system	- Familarisation with different sub-systems	- Core	
	- Cooling medium & arrangement		- Winding bars	
	- Winding & core support systems		- Assembly	
	b) Design aspects of other auxiliary systems		(b) Testing facilities	
MANDAYS	**30**	**15**	**15**	
Generator Excitation System including AVR.	Design features of various sub-systems	- Operational feed back	- Manufacturing process& testing facilities for various equipment of excitation system	
	Excitor	- Familiarisation with various equipment functioning at reference plants		
	PMG			
	Transformer			
	Controllers & different limiters etc.			
	PSS & associated system studies			
MANDAYS	**30**	**15**	**15**	

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
Boiler Feed pump H.T. Motor	Design Criteria for the Stator core & wdg Rotor core & wdg Insulation system Cooling arrangement	Operational feed back	Manufacturing process & test facilities	
MANDAYS	20		5	
POWER TRANSFORMER	**Equipment Theory & Maintenance Practice**			
MANDAYS	12	-	4	4
UPS/BATTERY CHARGER	**Equipment Theory & Maintenance Practice**			
MANDAYS	8	-	4	4
GIS	**Equipment Theory & Maintenance Practice**			
MANDAYS	24	4	12	24
SAS	**Equipment Theory & Maintenance Practice**			
MANDAYS	12	-	6	6

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
CRITICAL PIPING & POWER CYCLE PIPING	Design familiarization for critical piping of supercritical Plant	Familiarization with feed back (in super critical plant) on failure analysis and vibration analysis of piping.	Cold Setting of spring hanger	
	Optimization study for sizing including pressure drop calculation and selection of single or double lead together with Owner's engineers	Study of Feed back regarding hanger setting strategies and practice	Cyclic tests carried on spring hangers.	
	Design and stress analysis of lines with Expansion Joints together with Owner's engineers		Cyclic tests carried on expansion joints	
	Design and stress analysis of piping systems with two phase flow involving Owner's engineers		Manufacturing process of critical piping components and appreciation of their testing facilities at shop	
	Transient analysis and optimum sizing of feed suction piping together with Owner's engineers.			

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	**Plant Visit**	**Visit To Manufacturer's Work**	**Operation & Maintenance Of Plant**
	Static and dynamic analysis of critical piping including siesmic and other occassional load analysis (safety valve blowing condition). A joint activity together with Owner's engineers. Study and collection of data pertaining to special welding requirements (pre and post weld heat treat ment and electrode selection criteria etc.) of materials used in high temp piping system. Study and collection of data on special requirements in case of welding dissimilar metals and electrode selection criteria			
MANDAYS	**45**	**10**	**10**	

ANNEXURE-III

	Project : **Stage :** **Package :** **Supplier :** **Bidder No. :**	**LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL** **SUB-SYSTEM:**	**DOC. NO.:** **REV. NO.:** **DATE :** **PAGE : OF**

S. N.	Item	QP/ Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status/ category	Sub-supplier Details submission schedule	Remarks

LEGENDS

1. SYSTEM SUPPLIER/SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY the Owner)

A – For these items proposed vendor is acceptable to the Owner. To be indicated with letter "A" in the list alongwith the condition of approval, if any.

DR – For these items "Detailed required" for the Owner review. To be identified with letter "DR" in the list.

NOTED – For these items vendors are approved by Main Supplier and accepted by the Owner without specific vendor approval from the Owner. To be identified with "NOTED.'

2. **QP/INSPN CATEGORY**:

CAT-I : For these items the Quality Plans are approved by the Owner and the final acceptance will be on physical inspection witness by the Owner.

CAT-II : For these items the Quality Plans approved by the Owner. However no physical inspection shall be done by the Owner. The final acceptance by the Owner shall be on the basis review of documents as per approved QP.

CAT-III : For these items Main Supplier approves the Quality Plans. The final acceptance by the Owner shall be on the basis certificate of conformance by the main supplier.

UNITS/WORKS : Place of manufacturing Place of Main Supplier of multi units/works.

ANNEXURE-IV

	Project : S Package : Bidder : Bidder No. :	STATUS OF ITEM REQUIRING QP& SUB-SUPPLIER APPROVAL	DOC. NO.: REV. NO.: DATE : PAGE : OF

S. N.	Item/ Service	QP/ Insp. Cat.	QP Sub. Schedule Approval schedule	Date of sub-mission	Date of commt Appl.	Status Code C/II/I	Proposed Sub-suppliers	Place of manufacturing works	Approval Status	Sub-supplier detail submission schedule	Remarks