NC ENERGY
Limited
152, TTK ROAD, CHENNAI-600018 INDIA

To,
The Director,
Government of India,
Ministry of Environment and Forests,
Paryavaran Bhawan, CGO Complex, Lodhi Road,
New Delhi – 110 003

Kind Attention : Dr Saroj,

Madam,

Sub: 4x660 MW Super Critical Coal based Thermal Power Plant of M/s NC Energy Ltd near Village Athiyakurichi, Tiruchendur Taluk, Thoothukudi District, Tamilnadu – Issue of TOR – ***De novo*** – Reg.

Ref: 1) TOR letters no J-13012/41/2011-IA.II. (T) Dated 15-06-2011
2) TOR letter J-13012/41/2011-IA.II. (T)

We thank the Ministry for granting the TOR for the above mentioned project which is due for expiry in the month of June 2014. In this connection, we wish to apply for fresh TOR for the project. A copy of the TOR issued for the project is enclosed as Annexure to this letter.

We have completed the following activities for the project:

a) *Land to an extent of 503.18 acres out of 1300 acres has been acquired*
b) *Permission to draw water*
c) *NoC from the local village Panchayats obtained*

In light of the above, we are submitting the Revised Form1, TOR and Feasibility Report for obtaining the TOR (De novo) for the project both in hard copy and soft copy.

Thanking You,

Yours faithfully,

For NC Energy Ltd,

6/2/2014

(M.V.N.SURYPRASAD)
Chief Executive Officer

Encl: a/a

FORM – I (DENOVO)
TERMS OF REFERENCE
&
PRE FEASIBILITY REPORT

Of

2640 MW COAL BASED THERMAL POWER PLANT

(SUPERCRITICAL TECHNOLOGY)

Near Adiyakuruchi Village,
Tiruchendur Taluk,
Thoothukkudi District
(formerly Tuticorin)
Tamilnadu

February, 2014

BY

M/s. NC ENERGY LIMITED.,

CHENNAI

Prepared By

B.S. ENVI-TECH (P) LTD

Hyderabad – 500 057

FORM - I

APPENDIX I

FORM 1

(As Per New Notification of MoEF dated 1-12-2009 vide SO 3067 (E))

BASIC INFORMATION		
S. No	**Item**	**Details**
1	Name of the Project/s	**2640 MW (4 x 660MW) Coal based Thermal Power Plant based on supercritical technology** **M/s. NC ENERGY LTD., CHENNAI**
2	S. No. in the schedule	1(d)
3	Proposed capacity/ area/ length/ tonnage to be handled/ command area/ lease area/ number of wells to be drilled	2640 MW Coal based thermal power plant based on supercritical technology.
4	New/ expansion/ modernization	New Project
5	Existing capacity/ Area etc.	Nil
6	Category of Project i.e., 'A' or 'B'	**Category 'A'**
7	Does it attract the general condition? If yes please specify.	No
8	Does it attract the specific condition? If yes please specify.	No
9	Location	Near Adiyakurichi , Tiruchendur Taluk, Thoothukkudi District, Tamilnadu. Location map & 10 km map are enclosed as **Annexure – 1 and 1a** respectively.
	Plot/ Survey/ Khasra No	Enclosed as **Annexure-2**
	Village(s)	**Adiyakurichi, Udangudi and Kulasekarapattinam**
	Tehsil	**Tiruchendur**
	District	**Thoothukkudi (Tuticorin)**
	State	**Tamil Nadu**
10	Nearest railway station/ airport along with distance in Km.	**Railway Station –** Tiruchendur –15 km **Airport :** Tuticorin – 52 km
11	Nearest town, city, district headquarters along with distance in km.	**Towns:** Tiruchendur – 15 km **City :** Tuticorin – 52 km

12	Village panchayats, Zilla parishad, Municipal Corporation, Local body (Complete postal addresses with telephone nos to be given)	Kulasekarapattinam
13	Name of the applicant	**NC ENERGY LTD.,**
14	Registered address	159, TTK ROAD, ALWARPET, CHENNAI- 600 018
15	Address for correspondence	
	Name	**Mr. M.V.N. SURYAPRASAD**
	Designation (Owner /Partner/ CEO)	**Chief Executive Officer**
	Address	159, TTK ROAD, ALWARPET, CHENNAI
	Pincode	600 018
	E- mail	surya @ nelcast.com
	Telephone no.	044-24983111
	Fax no.	044-24982111
16	Details of Alternative sites examined, if any location of these sites should be shown on a topo sheet.	The following three sites were evaluated ***SITE – 1 : Near Vembar*** ***SITE – 2: Near Anaikudi*** ***SITE – 3: Near Adiyakurichi Village, Tiruchendur Taluk, Thoothukkudi District,(formerlyTuticorin), Tamilnadu*** ***Site 3 is the selected site.*** **(Annexure – 3)** ***The TOR for this site (Site 3) was issued vide Lr No J-13012/41/2011-IA.II(T)dated 15-06-2011. This was valid upto 15-06-2013. The same was renewed for one more year vide Lr. No J-13012/41/2011-IA.II(T)*** ***The validity of the same is expiring on 15.6.2014***
17	Interlinked projects	Nil
18	Whether separate application of interlinked project has been submitted?	Not Applicable
19	If yes, date of submission	Not Applicable
20	If no, reason	-

21	Whether the proposal involves approval/ clearance under: if yes, details of the same and their status to be given. (a) The Forest (Conservation)Act, 1980 (b) The Wild Life (Protection)Act, 1972 (c) The CRZ Notification, 1991	Yes. It is proposed to draw sea water for the power project. Hence the project requires CRZ approval for the intake of sea water and discharge of waste water
22	Whether there is any Government Order/ Policy relevant/ relating to the site?	No
23	Forest land involved (hectares)	Nil. No forest land is involved
24	Whether there is any litigation pending against the project and/or land in which the project is propose to be set up? (a) Name of the court (b) Case No (c) Orders/ directions of the court, if any and its relevance with the proposed project.	Nil
25	Expected cost of the project	Total Cost of the Project – Rs. ***15,154.40*** Crores.

(II) Activity

1. Construction, operation or decommissioning of the Project involving actions, which will cause physical changes in the locality (topography, land use, changes in water bodies, etc.)

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
1.1	Permanent or temporary change in landuse, land cover or topography including increase in intensity of land use (with respect to local landuse plan)	Yes	The land identified for the project is about 1300 acres and the proposed site comprises thorny scrub and coconut plantations. As on date, the company has acquired about 503.18 acres of land in the following villages Adiyakurichi, Kulasekarapattinam, and Udangudi. The location Map, 15 KM radius Landuse / Landcover map prepared by ANNA UNIVERSITY is given in **ANNEXURE – 1 and 1a.** The village wise survey numbers of the identified land is given in **Annexure - 2.**
1.2	Clearance of existing land, vegetation and building?	Yes	The site comprises of scrub and patches of plantation (mainly Palmyra /Coconut trees). Details will be furnished in EIA.
1.3	Creation of new land uses	Yes	Industrial land use
1.4	Pre-construction investigations e.g. bore houses, soil testing?	Yes	Geotechnical investigations will be done prior to construction activity.
1.5	Construction works?	Yes	Administration building, power house, workshops, stacks etc. will be constructed
1.6	Demolition Works?	No	Not applicable
1.7	Temporary sites used for construction works or housing of construction workers?	Yes	Laydown area and temporary housing area will be located near the proposed site.
1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations	Yes	All the structures will be constructed above the ground except for ash pond. The site is flat and involves minimum cut and fill. Details will be furnished in the EIA report.
1.9	Underground works including mining or tunnelling?	No	Not applicable
1.10	Reclamation works?	No	Not applicable
1.11	Dredging?	Yes	The location for intake / marine outfall will be identified based on

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
			the Bathymetry Study. The requirement of dredging and management of dredged material disposal will be covered under the Rapid Marine Impact Assessment Study.
1.12	Offshore structures?	No	Not applicable
1.13	Production and manufacturing Process?	Yes	The proposed power project will generate electricity and supply to the Grid. The generation of electricity is done using modern efficient technology (supercritical).
1.14	Facilities for storage of goods or materials?	Yes	Storage facilities are planned for goods and materials during construction period both open and covered areas.
1.15	Facilities for treatment or disposal of solid waste or liquid effluents?	Yes	During construction, the temporary housing colony will be provided with a septic tank facility for handling the sewage. A designated area will be provided for garbage disposal. Details will be furnished in EIA.
1.16	Facilities for long term housing of operational workers?	Yes	Residential township will be developed separately. Location of the colony and number of houses will be finalised. Details will be furnished in EIA
1.17	New road, rail or sea traffic during construction of operation?	Yes	An alternate road for approaching the site bypassing the villages if any will be developed. Details will be furnished in Draft EIA report
1.18	New road, rail, air waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc.?	Yes	The sea water intake, waste water disposal pipelines, is the new infrastructure to be developed. Details will be furnished in Draft EIA report/ Rapid Marine EIA report
1.19	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?	Yes	Required minor road diversions. Details will be furnished in the EIA report
1.20	New or diverted transmission lines or pipelines?	Yes	New transmission line and pipelines to be laid. Details will be furnished in the EIA report.
1.21	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?	No	Not applicable

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
1.22	Stream crossings?	No	
1.23	Abstraction or transfers of water form ground or surface waters?	Yes	From Bay of Bengal at a distance of 2.0 km
1.24	Changes in water bodies or the land surface affecting drainage or run-off	No	Not applicable
1.25	Transport of personnel or materials for construction, operation or decommissioning?	Yes	Construction materials and equipment will be transported by Road and rail.
1.26	Long-term dismantling or decommissioning or restoration works?	No	Not applicable
1.27	Ongoing activity during decommissioning which could have an impact on the environment?	No	Not applicable
1.28	Influx of people to an area in either temporarily or permanently?	Yes	Involves temporarily the influx of people from nearby villages during construction period.
1.29	Introduction of alien species?	No	Not applicable; Local native species will be planted
1.30	Loss of native species or genetic diversity?	No	Not applicable
1.31	Any other actions?	No	Not applicable

2. Use of Natural resources for construction or operation of Project (such as land, water, materials or energy, especially any resources which are non-renewable or in short supply).

Sr. No.	Information/Checklist Confirmation	Yes/ No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
2.1	Land specially undeveloped or agricultural land (ha)	Yes	The land identified for the project is private land. It is a scrub land or land having Palmyra / coconut trees (low yield).
2.2	Water (expected source & competing users) unit KLD	Yes	Construction Req : 300 KLD Operational Req: 6,27,000

Sr. No.	Information/Checklist Confirmation	Yes/ No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
			M^3/day (Sea water will be used). Details furnished in **Annexure - 4**
2.3	Minerals (MT)	No	Not Applicable
2.4	Construction material – stone, aggregates, and/soil (expected source-MT)	Yes	From nearby sources
2.5	Forests and timber (source-MT)	No	Not applicable
2.6	Energy including electricity and fuels (source, competing users) Unit: fuel (MT), energy (MW)	Yes	Construction Power from Grid – 3 MW a) 100% imported coal b) Blend coal (70% indigenous + 30% imported coal) Details furnished in **Annexure - 4**
2.7	Any other natural resources (use appropriate standard units)	No	-

3.0 Use, storage, transport, handling or production of substances or materials, which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
3.1	Use of substances or materials, which are hazardous (as per MSIHC rules) to human health or the environment (flora, fauna, and water supplies)	Nil	Not applicable
3.2	Changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)	No	Not applicable
3.3	Affect the welfare of people e.g. by changing living conditions?	Yes	Potential for both direct and indirect employment benefits.
3.4	Vulnerable groups of people who could be affected by the project e.g. hospital patients, children, the elderly etc.,	No	Not applicable
3.5	Any other causes	No	Not applicable

4.0 Production of solid wastes during construction or operation or decommissioning (MT/month)

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
4.1	Spoil, overburden or mine wastes	No	The spoil generated during construction will be reused for construction as well as for filling. Details will be furnished in the EIA Report.
4.2	Municipal waste (domestic and or commercial wastes)	Yes	Domestic sewage from admin buildings. Septic tanks with soak pits will be provided for admin buildings and temporary housing colony.
4.3	Hazardous wastes (as per hazardous waste management rules)	Yes	Waste oil and used batteries are envisaged. These will be stored in designated areas and disposed as per TNPCB laid down norms
4.4	Other industrial process wastes	Yes	Ash from burning of coal is the main process related waste
4.5	Surplus product	No	-
4.6	Sewage sludge or other sludge from effluent treatment	Yes	Sludge from raw water treatment plant.
4.7	Construction or demolition wastes	No	Excavated earth will be reused. All construction waste will be properly stacked and removed by the Main contractor before handing over the site.
4.8	Redundant machinery or equipment	No	Not applicable
4.9	Contaminated soils or other materials	No	Not applicable
4.10	Agricultural wastes	No	Not applicable
4.11	Other solid wastes	No	Not applicable

5.0 Release of pollutants or any hazardous, toxic or noxious substances to air (kg/hr)

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources	Yes	During construction, DG sets will be used. The movement of trucks carrying the material are the main sources.
5.2	Emission from production processes	Yes	Particulate Matter, Sulphur

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
			dioxide, Oxides of Nitrogen due to burning of coal.
5.3	Emissions from materials handling including storage or transport	Yes	Fugitive dust due to storing of coal, conveyance of coal
5.4	Emissions from construction activities including plant and equipment	Yes	Fugitive dust during construction is a temporary phenomenon.
5.5	Dust or odours from handling of materials including construction materials, sewage and waste	Yes	Fugitive dust from construction activity. There will not be any odour causing source.
5.6	Emissions from incineration of waste	No	Not applicable
5.7	Emissions from burning of waste in open air (e.g. slash materials, construction debris)	No	Not applicable
5.8	Emissions from any other sources	No	Not applicable

6.0 Generation of Noise and vibration, and emissions of Light and heat

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
6.1	From operation of equipment e.g. engines, ventilation plant, crushers	Yes	The operation of DG sets, welding and other construction activities are the major sources of The expected ambient noise levels will comply with National Ambient Noise Standards.
6.2	From industrial or similar processes	Yes	The main noise generating equipment in a power plant are the boiler feed pumps, air compressors, steam turbines, generators and fans. All these equipment will be provided with enclosures which will minimise the spot noise levels. The power plant will comply with the National Ambient Noise Standard. Details will be furnished in EIA.
6.3	From construction or demolition	Yes	Noise will be generated during construction activities. Workers will be provided with protective equipment such as earmuffs etc.
6.4	From blasting or piling	Yes	From piling

6.5	From construction or operational traffic	Yes	During construction the material will be transported by road. During operation of plant traffic will be very less limited to transportation of employees only.
6.6	From lighting or cooling systems	Yes	Noise from cooling tower fans
6.7	From any other sources	No	-

7.0 Risks of contamination of land or water from releases of pollutants into the ground or into sewers, surface waters, groundwater, coastal wasters or the sea

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
7.1	From handling, storage, use or spillage of hazardous materials	Yes	Risk of fire due to storage of coal (spontaneous combustion), storage of fuels like Diesel oil and gases like Hydrogen.
7.2	From discharge of sewage or other effluents to water or the land (expected mode and place of discharge)	Yes	The liquid waste is classified as plant waste and domestic sewage from administration buildings etc.
7.3	By deposition of pollutants emitted to air into the land or into water	Yes	Emission of pollutants due to burning of coal is furnished in **Annexure 4.**
7.4	From any other sources	No	Not envisaged
7.5	Is there a risk of long term build-up of pollutants in the environment from these sources?	No	Not envisaged

8.0 Risk of accidents during construction or operation of the project, which could affect human health or the environment

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
8.1	From explosions, spillages, fires etc. from storage, handling, use or production of hazardous substances	Yes	From storage of coal, fuel oil and cooling gas like hydrogen.
8.2	From any other causes	No	Not envisaged
8.3	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslides, cloud burst etc)?	Yes	Cyclones

9.0 Factors which should be considered (such as consequential development) which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality

Sr. No.	Information/Checklist Confirmation	Yes/No	Details thereof (which approximate quantities/ rates, wherever possible) with source of information data
9.1	Lead to development of supporting facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g.:	Yes	Supporting and ancillary development will take place.
	Supporting infrastructure (roads, power supply, waste or waste water treatment, etc.)	Yes	Basic infrastructure will be developed in area.
	Housing development	Yes	A colony will be developed
	Extractive industries	Yes	On the availability of power, the small and medium industries will also be developed in this region
	Supply industries	Yes	
	Other		
9.2	Lead to after use of the site, which could have an impact on the environment	No	-
9.3	Set a precedent for later developments	No	-
9.4	Have cumulative effects due to proximity to other existing or planned projects with similar effects	No	As on date the following power plants are proposed in the vicinity of NC Energy Power Plant • BHEL-TNEB Power Plant near Udangudi • 2x660 MW Power Plant of Ind Bharath Group. However, the same will be ascertained during the EIA study and cumulative impacts if any will be analysed for plants which exist/proposed within 10 km radius (study area) of the project.

(III) Environmental Sensitivity

Sr. No.	Areas	Name/ Identity	Aerial distance (within 15 km) Proposed project location boundary
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	Nil	NA
2	Areas which are important or sensitive of ecological reasons – wetlands, water courses or other water bodies, coastal zone, biospheres, mountains, forests	Gulf of Mannar Biosphere Reserve (GOMBAR)	34 km from the project site
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	Nil	
4	Inland, coastal, marine or underground waters	Yes	Coastal
5	State, national boundaries	No	-
6	Routes or facilities used by the public for access to recreation or other tourist, pilgrim areas	No	-
7	Defence installations	No	-
8	Densely populated or built-up area	Tiruchendur Town	15 km
9	Areas occupied by sensitive man made land uses *(hospitals, schools, places of worship, community facilities)*	Tiruchendur Town	15 km
10	Areas containing important, high quality or scarce resources *(ground water resource, surface resources, forestry, agriculture, fisheries, tourism, minerals)*	Nil	
11	Areas already subjected to pollution or environmental damage. *(those where existing legal environmental standards are exceeded)*	No	The banned area under CEPI index is Cuddalore which is at a distance of 400 km from the site. B
12	Areas susceptible to natural hazard which could cause the project to present environmental problems *(earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions)*	Yes	The area experiences cyclones

"I hereby give under taking that the data and information given in the application and enclosures are true to the best of my knowledge and belief and I am aware that if any part of the data and information submitted is found to be false or misleading at any stage, the project will be rejected and clearance give, if any to the project will be revoked at our risk and cost.

Date: 06-02-2014

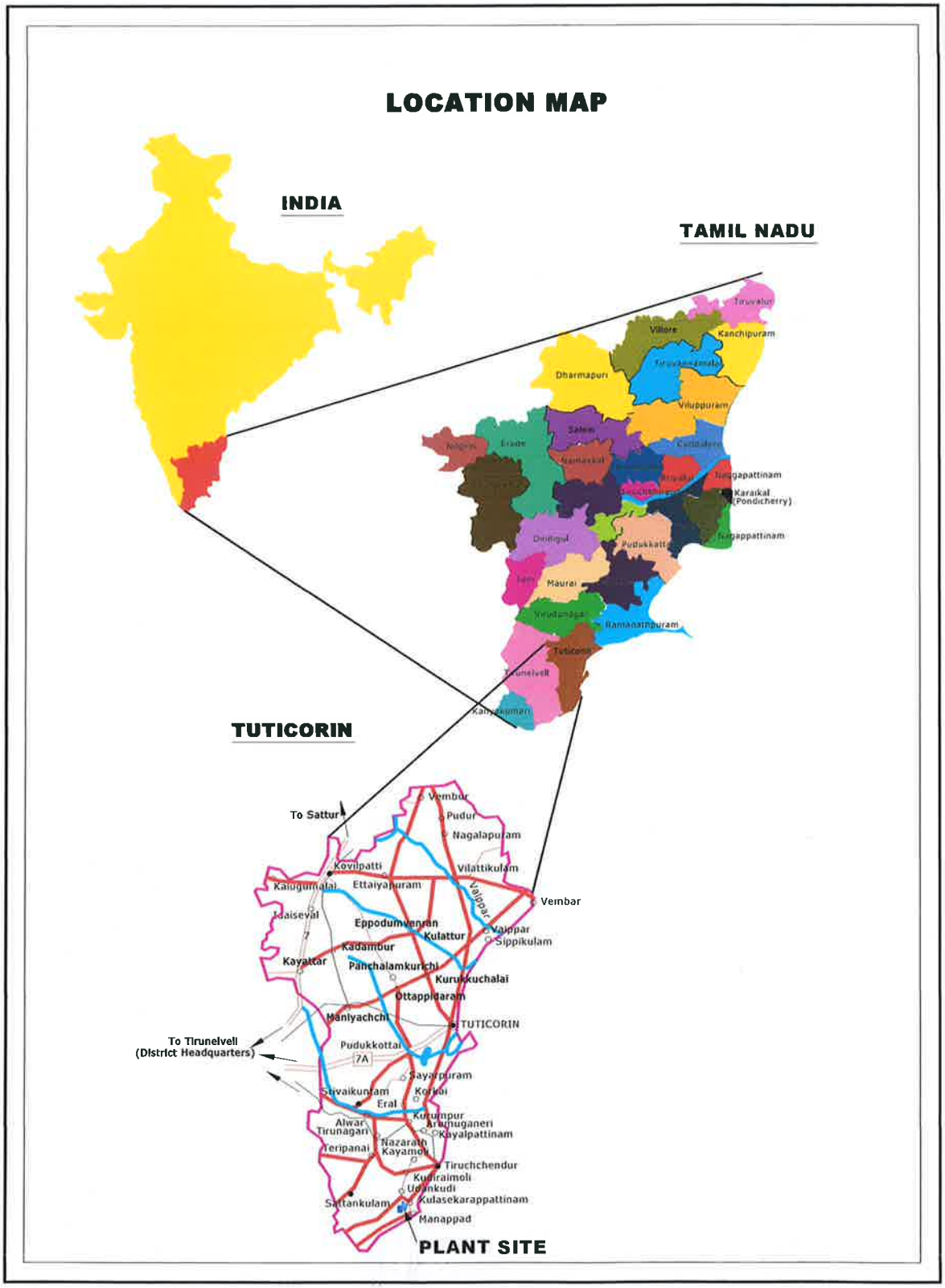
Place : Chennai

Signature of the Applicant (Project proponent / Authorized signatory)	6/2/2014
Name	**M.V.N.SURYAPRASAD**
Designation	Chief Executive Officer (Authorised Signatory)
Address	**NC ENERGY LTD.,** 159, TTK ROAD, ALWARPET, CHENNAI- 600 018

FORM 1 - ANNEXURES

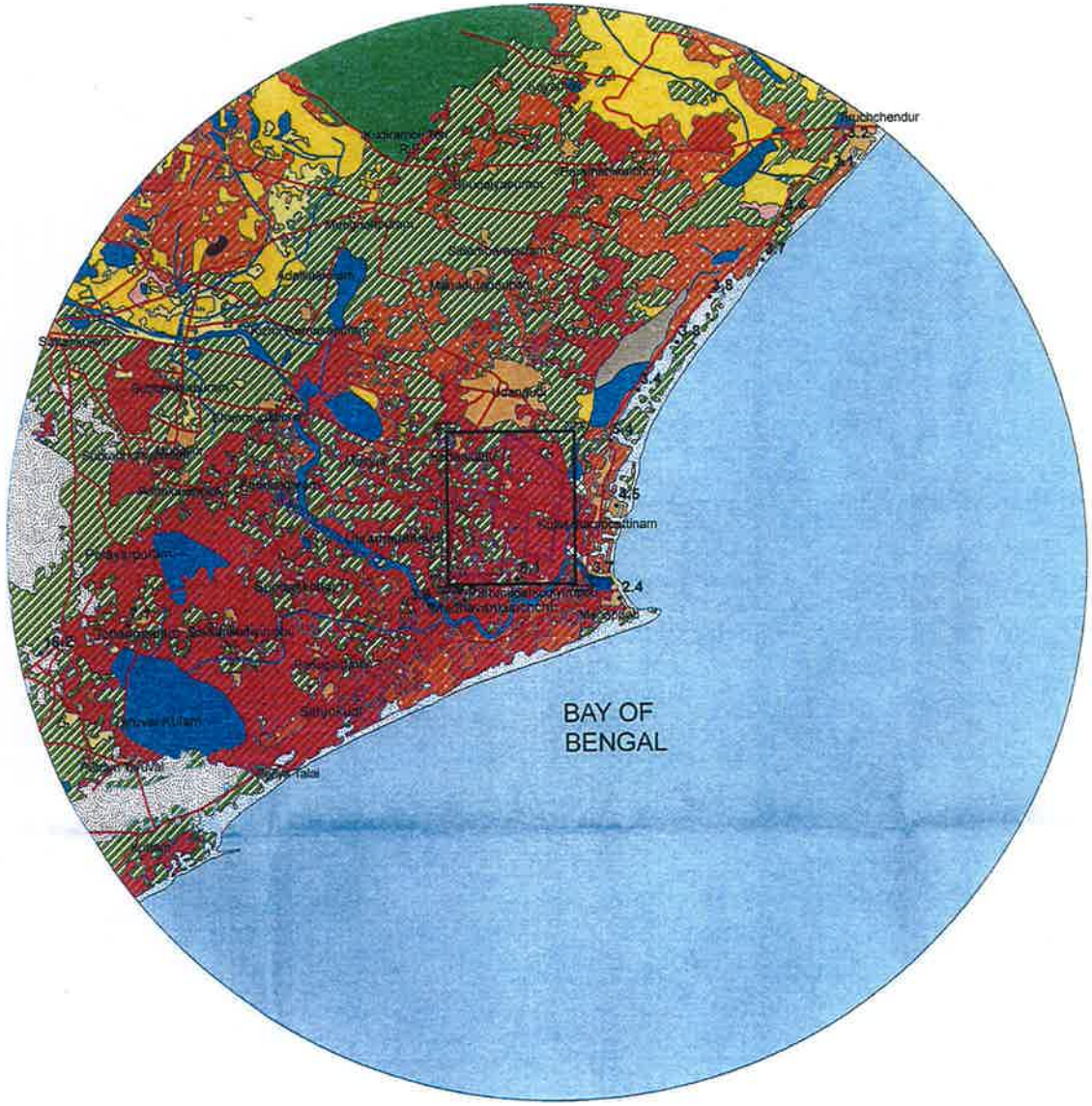
ANNEXURE - 1

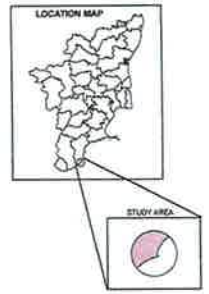
LOCATION MAP



LAND USE/LANDCOVER MAP FOR A RADIUS OF 15 KM FROM THE PROJECT SITE IN THOOTHUKKUDI DISTRICT

ANNEXURE - 1A





Legend

COASTAL SAND	BUILT UP
BARREN ROCKY	INDUSTRY
SALT PAN	AGRICULTURAL LAND
RIVER/CANAL	FALLOW LAND
TANKS	PLANTATION
CREEK	FOREST
SAND DUNES	SALINITY
FILLED UP	DENSE SCRUB
OCEAN	OPEN SCRUB
ROAD	PROJECT SITE
STREAM	BENCH MARK

Approx Distance in Km

Manappad	–	Project site	2.01
Kudiramoli RF	–	Project site	10.81
Madhavakurichchi	–	Project site	1.34
Kulasekarapattinam	–	Project site	1.74

PREPARED BY
Institute of Remote Sensing
Anna University,Guindy
Chennai- 600 025

PREPARED FOR
Proposed 4 X 660 MW
Coal based Thermal power plant of
NC ENERGY Limited
Chennai

PREPARED BY

VERIFIED BY

APPROVED BY

Dr. M.RAMALINGAM, BE,MS,Ph.D.,
Director
Institute of Remote Sensing
Anna University Chennai-600 025.

SCALE 1 :100,000
1 0.5 0 1 2 3 4 5 Kilometers

77°50'0"E 77°55'0"E 78°0'0"E 78°5'0"E 78°10'0"E 78°15'0"E

ANNEXURE - 2

LIST OF SURVEY NUMBERS OF IDENTIFIED LAND

NAME OF VILLAGE	UDANGUDI
S.NOS.	106,108,109,110,111,113,114,115,116,117,118,119,120,121,122,123,124,125,126,127,128,129,130,131,132, 133,134 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148,152,153,154,155,156,

NAME OF VILLAGE	ADIYAKURICHI
S.NOS.	09, 10, 2,13,14,15,17,18,19,20,25,26,27,28,.29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45, 46,47,49,50,51,52,53,54,55,56,57,58,59,61,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77, 78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95, 117,118,120,123,124,125,126,127,130,131,132,133,134,135,136,137,138,140,141,144,145,397,112,113,114,115, 151 to 173,189,191,192,193,194,195,196,197,198,199,200,201,202,203,204,205,206,207,208,209,210,211,212,213,214to219,220,221,222,223,224,225,226,227,228,229,230,231,248,249, 250,266,267,268,269,270,271,272,273,274,275,276,277,278,279,282,283,284,285,286,287,288,289, 290, 291,292,293,294,295,296,297,298,299,300,301,302,303,304,305,306,307,308,309,310,326,324,325,326,328,329,330,331 TO 409,

NAME OF VILLAGE	KULASEKARAPATTANAM

S.NOS.	314 TO 322, 326 TO 351, 406,407,408,419 TO 464

ANNEXURE - 3

ALTERNATE SITES

SITE - 1 : Near Vembar

Total Area : About 1400 ac.

Type of Land : Scrub

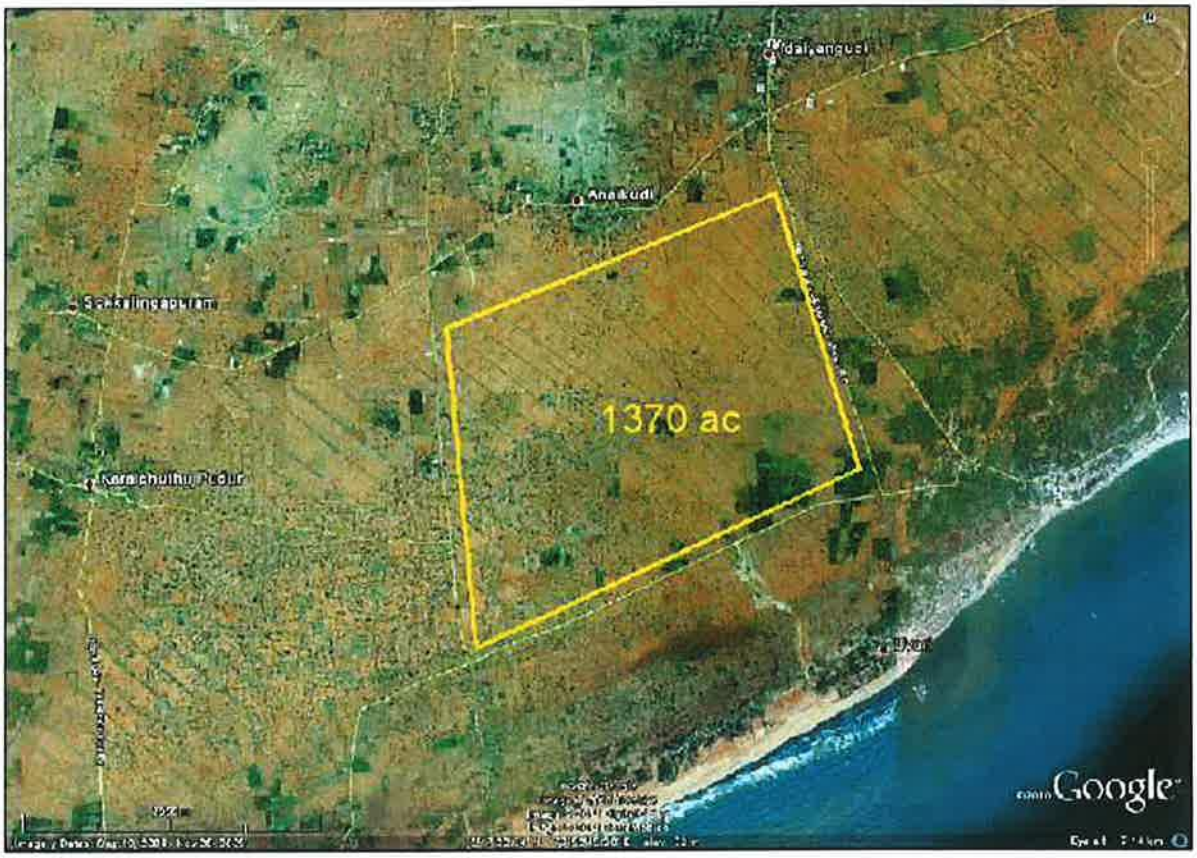
Reason for not selecting : Site is close to Gulf of Mannar Biosphere Reserve (GOMBAR)

SITE - 2 : Near Anaikudi

Total Area : About 1400 ac.

Type of Land : Scrub & Palm Trees

Reason for not selecting : Land documentation is not proper



SITE - 3 : Near Adaikurichi Village

Total Area identified : About 1700 ac.

Type of Land : Scrub and coconut trees

Selected site : **This site has been selected**

ANNEXURE - 3

WATER BALANCE (m^3/day)
(4 X 660 MW)

						Require-Ment	Usage (U) /Loss (L)	Waste Water
A.	**COOLING WATER**							
Cooling Water including auxiliary cooling						547456	126336	421120

B.	**NON – COOLING WATER**							
Clarifier						31424	0	31424
	Filtration					4656	0	4656
		First RO pass	Desal reject			28240	0	28240
			Misc Services			12600	12400	200
			Domestic – Plant			44	10	34
			Second RO pass			380	380	0
				DM Plant		64	0	64
					Boiler Feed	2016	2016	0
TOTAL						626880	141142	485738

Annexure - 4

COAL ANALYSIS (typical quality)

		Imported coal (Indonesia)	**Indigenous Washed Coal**	**Blend coal** (70% indigenous washed coal 30 % imported coal)
Moisture	% by wt	34	10.6	17.62
Ash Content		15	34	28.3
Volatile Matter		24.4	27.4	26.5
Fixed Carbon		26.6	28	27.58
Total Sulphur		0.6	0.3	0.39
Gross Calorific value – Air Dried	kcal/kg	**4100**	**3800**	**3890**

ANNUAL COAL REQUIREMENT

COAL		**4 x 660 MW**
Coal consumption **(Imported coal)**	TPD	35380
	*MTPA	10.96
		Or
Coal consumption **Blend coal** (70% indigenous coal and 30% imported coal)	TPD	39106
	*MTPA	12.13

*Note MTPA ; Million Tonnes per Annum (Value at 85 % PLF)

EMISSION DETAILS
(4 X 660 MW)

	IMPORTED COAL		**BLEND COAL (70 % Indigenous coal and 30 % imported coal)**	
	2 X 660 MW	**2 X 660 MW**	**2 X 660 MW**	**2 X 660 MW**
No. Of units	2	2	2	2
Coal Consumption (t/hr/unit)	368.52	368.52	407.36	407.36
Sulphur content (%)	0.60	0.60	0.39	0.39
No. Of stacks	1	1	1	1
No of Flues in each stack	2	2	2	2
Height of stack, m	275	275	275	275
Diameter of each flue(m)	7.0	7.0	7.0	7.0
Temperature of flue gas (°C)	140	140	140	140
Velocity of flue gas (m/s)	25.00	25.00	25.0	25.0
Particulate matter at outlet of ESP (gm/sec/flue) (based on 50 mg/Nm^3 at outlet)	32.32	32.32	34.9	34.9
Sulphur dioxide emission (gm/sec/flue)	1228.4	1228.4	882.6	882.6
Oxides of Nitrogen (gm/sec/flue) (based on 750 mg/Nm^3 at outlet)	485.0	485.0	523.5	523.5

ASH GENERATION
(MILLION TONES PER ANNUM)
(4 X 660 MW)

	Imported coal		**Blend Coal** (70 % Indigenous Coal and 30 % Imported coal)
Total Ash	1.64 (@15 % ash content on coal)	Or	3.43 (@28.3 % ash content on coal)
Fly Ash (@80%)	1.31		2.74
Bottom Ash (@20%)	0.32		0.69

TERMS OF REFERENCE

TERMS OF REFERENCE

FOR

CONDUCTING THE EIA STUDY

OF

2640 MW COAL BASED POWER PLANT (SUPER CRITICAL TECHNOLOGY)

Near Adaikuruchi Village,
Tiruchendur Taluk,
Thoothukkudi District
(formerly Tuticorin)
Tamilnadu

PROJECT DEVELOPER

NC ENERGY LTD.,

CHENNAI

TERMS OF REFERENCE

(IV) Proposed Terms of Reference for EIA Study

Project Implementation:

A detailed description of all elements of the project during the pre-construction, construction and operational phases will be prepared. The elements analyzed will include the infrastructures of the project including: drainage features, roads, waste collection, disposal and management and utility requirements.

Analysis and assessment of designs to ensure environmental soundness, sustainability and regulatory compliance of the designs will be studied and incorporated in the Draft and Final REIA Report.

Analysis of Alternatives:

As per the new EIA notification dated 14th September, 2006 site selection criteria need not prepared separately. Hence the site selection criteria will not be covered under this study. However, alternate site analysis will be incorporated in the REIA report.

Field Assessments:

Field assessments of the physical, ecological, and socioeconomic aspects of the site and associated environs will be conducted. These assessments will be used to determine the potential impacts, if any, of the proposed project. The assessments will include:

- **Physical:**

Climate, air quality, geology, topography, groundwater/surface water hydrology and quality and hazard vulnerability.

- **Ecological:**

Terrestrial and aquatic communities; presence of rare, threatened, and endangered species.

- **Socioeconomic:**

Demography, regional setting, location assessment, and land uses.

The technical scope of work for carrying out the baseline monitoring will be as given below. The baseline monitoring will be carried out in 10-km radius study area around the proposed project site for three Months representing one Non-Monsoon Season.

Sr. No.	Attributes	Scope of Work
1	Ambient Air Quality	8 Locations - **2 days/week for 12 weeks (3 months)** PM 2.5, RPM, SO_2, NOx, HC and CO will be monitored as per CPCB guidelines. Design of ambient air quality sampling network with regard to topography, population, sensitive locations, emission sources, background concentrations and possible impact zones, through application of screening air quality models for assessing the maximum GLC zones prior to start of baseline study.
2	Meteorological data	1 Location - **90 days** Wind speed, direction, temperature, humidity, cloud cover and rainfall will be monitored. This is to be further supported by the meteorological data for the area of interest from the nearest meteorological observatory and Trend analysis of micrometeorological data generated at the site.
3	Water Quality	**10 Locations- (Surface and Ground water samples)** – Once during the EIA study Parameters as per IS-10500. The survey also include estimation of water balance and assessment of impacts on regional water demand and availability of fresh water due to drawl of water for plant, recommendations on water conservation and rain water harvesting measures based on past experience on similar projects; and identification of suitable location and methodology for disposal of waste water form all sources.
4	Soil Quality	**8 Locations** once during EIA study. Parameters related to afforestation, nutrients, pollutants etc will be carried out.
5	Noise Levels	**8 Locations (Residential, Commercial and Sensitive areas)** once during EIA study. Readings will be taken for 24-hr duration at each location
6	Land use	Land use as per the district census handbooks as well as with the help of satellite imagery will be presented in 10-km radius study area.
7	Solid waste	Characterization of all the solid wastes generated from the plant operations and its disposal including impacts due to disposal.
8	Geology and Hydro-geological aspects	These aspects will be covered for 10-km radius study area for proposed project site. The data will be compiled from the secondary sources only.
11	Socio-Economic and Health aspects	Socio-economic and health aspects will be covered for 10-km radius study area based on the Census documents and NIC database.
12	Ecological studies (Terrestri	Flora and fauna will be studied in 10-km radius study area. These studies will be based on primary as well as secondary sources.

Sr. No.	Attributes	Scope of Work
	al and Aquatic)	A Rapid Marine Impact Assessment study will be carried out for identifying the impacts due to abstraction and discharge of water and Jetty operation. The survey also includes assessment of the species diversity, density, abundance etc. in the study area and formulation of ecological indexes, assessment of likely changes on flora and fauna due to the project related activities, suggestions for conservation and protection of flora and fauna in the study area and suggestions for development of new conservation areas locally.

Detailed qualitative assessments of the physical, ecological, and socioeconomic conditions associated with the site in the Draft and Final Report.

Legislation and Regulatory Considerations:

Government policies, legislation and regulations relevant to the proposal will be identified. Local plans and policies will also be evaluated. Project characteristics will be analyzed to ensure compliance with these policies, legislation and regulations. Appropriate recommendations will be provided to ensure regulatory compliance.

The legislation relevant to the project will be summarized and presented in the Detailed EIA Reports.

Environmental Impact Assessment

The baseline data generated from above studies will be analyzed and compared with applicable standards for each environmental attribute so that the critical environmental areas and also attributes of concern will be identified. The short term and long-term impacts particularly on sensitive targets such as endangered species, plants and historically important monuments will be identified.

The Environmental Impact Assessment of proposed project will be done on above basis to determine the environmental acceptability of this proposed project in absence of control measures and after implementation of the mitigation measures, including worst impact.

A qualitative and quantitative assessment of pollution aspects of proposed project (air and dust, wastewater, noise pollution, wastewater discharges etc.) will also be done to identify the adequacy of the proposed control measures as well as the likely impact on existing critical areas. Mitigation measures to reduce adverse impacts will be suggested.

Air Impacts :

Emission Inventory will be carried in an area of 10-km around the project site. A computer based internationally recognized mathematical air quality model (AERMOD) will be used to model the air pollution impacts due to the operation of the power plant. The model would also take into account other sources of pollution and topographical features of the area.

The emission of relevant pollutants from nearby sources shall be used in the model for more accurate estimate of air quality. The results will be presented as isopleths (pollutant concentrations) over a radius of 10-km around the plant site. Alternatively, a cumulative emission source modelling will be conducted for the project area covering 15 km radius.

The dispersion model results will be included in the report using isopleths or other graphical methods, over laying a land use map of the surrounding area. The predicted air quality will be compared with existing regulations and mitigative measures, if any, will be identified. The long term and short term impact at all the monitoring locations shall also be estimated.

Noise Impacts :

Sources of noise and its impact on the environment would be clearly brought out. The noise level at varying distances for multi-sources will be predicted using suitable model. A comparison of measured noise (Leq) at monitoring locations to that of predicted noise levels (Leq) would be made and mitigatory measures required, if any, will be recommended to conform to regulatory ambient air noise standards. We propose to estimate increase in noise levels over the baseline conditions in different zones like industrial, residential and sensitive areas like hospitals, wild life habitation etc. The potential noise level exposure will be determined and evaluated for acceptable limits of exposure.

Environment Management Plan

For each potential negative impact identified, recommendations will be presented for avoidance, minimization or mitigation of impacts along with costs associated with potential mitigation. An EIA/EMP, based on three months baseline study, will be prepared for the project. The EMP will address the following:

- Identify and summarize all anticipated significant adverse environmental impacts:
- Identify and summarize all mitigation measures, including the type of impact to which it relates and the conditions under which it is required;
- Define a set of policies and objectives for environmental performance and continual enhancement of performance;
- Recommend monitoring measures including the parameters to be monitored, methods to be used, sampling locations, frequency of measurements, detection limits and definition of thresholds that will signal the need for corrective actions;
- Recommend monitoring and reporting procedures;

- Recommend capacity development and training requirements for implementation of EMP;
- Recommend an organizational structure for effective implementation of the EMP; and
- Draw up an implementation and cost schedule for EMP.

Environmental Monitoring

Environmental monitoring and management plan will be developed for the sensitive elements of the environment including marine environment that may require monitoring during construction and operations of the facility. Recommendations will be made on the institutional arrangements that will be necessary to ensure effective monitoring and management. A detailed management and monitoring program will be developed to reduce the effects of potential negative environmental impacts.

Risk Assessment and Disaster Management Plan

Risk Assessment studies comprising sub-activities such as hazard identification, assessment and quantification of risk for suggesting risk mitigation measures based on Maximum Credible Accident (MCA) Analysis to be carried out for the proposed project. Preparation of the Risk Assessment Report will be followed by Disaster Management Plan (DMP) and Emergency Preparedness Plan (EPP) based on the quantitative Risk Assessment of the proposed activity and associated infrastructure for the project.

Community Development Plan

Community Development Plan will be prepared based on need based assessment study and as per MoEF guidelines. The same will be incorporated in the EIA report.

PRE FEASIBILITY REPORT

PRE FEASIBILITY REPORT

Of

2640 MW (4 x 660 MW)

COAL BASED THERMAL POWER PLANT

(SUPERCRITICAL TECHNOLOGY)

Near Adaikuruchi Village,
Tiruchendur Taluk,
Thoothukkudi District
Tamilnadu

BY

M/s. NC ENERGY LIMITED.,

CHENNAI

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LIST OF ANNEXURES

1

Executive Summary

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION.

The objective of this Prefeasibility Report is to establish the project preliminary details for 4x660MW capacity (2640 MW) supercritical thermal power project, such as site features, basic plant configuration, salient technical features, project execution plan and the financial requirements of the proposed Power Plant in Tuticorin district of Tamilnadu state. This project is being developed through a Special Purpose Vehicle, M/s NC ENERGY LTD which is a group Company of M/s Nelcast ltd.

NC Energy Limited (NCEL) is a Nelcast Group Company. Nelcast Limited, established in 1985, has grown into India's largest producer of SG iron castings and a leading producer of grey iron castings. Nelcast has shown an astounding growth rate, growing to 250 times its original size to reach its current capacity of 150,000 MT. It plans to expand the capacity in the coming years. Nelcast currently supplies components to a wide spectrum of customers and is committed to satisfy the varying and diverse customer requirements. NCEL has envisaged to set up a 4 x 660 MW supercritical imported coal based units at Kulasekarapattinam, Tuticorin District, in state of Tamil Nadu.

The State of Tamil Nadu is poised for rapid industrial development and large-scale use of electricity, for which the demand for electrical power is continuously increasing. The present demand for electrical power is greatly in excess of the generating capacity. The power generation scenario in the state reveals that the demand for power will continue to out-strip the available and planned generation capacity. Further, it is expected that the on going liberalization of the country's economic policy would accelerate the industrial growth, which would increase the demand for power. Accordingly, this would result in large shortfall in the availability of both power and energy.

In order to reduce the large gap between the demand and availability, the Government of India has enacted a number of policy changes to allow participation of the private sector in power generation, which is highly capital intensive. The government has also brought out the necessary changes in legal, administrative and economic environment to attract private sector participation in power generation. With this background, NCEL

proposes to develop a green field 2640 MW domestic and imported coal fired thermal power project in the coastal region of Kulasekarapattinam about 50 km away from Tuticorin town in the State of Tamil Nadu.

Installed capacity of the proposed project is more than 1000 MW and part of the power generated is proposed to be sold outside the state of Tamil Nadu, the project would qualify for 'Mega Project status'. NCEL would apply to the concerned authorities for 'Mega Power Project status' in order to avail of various incentives including concessional taxes & duties, as per the 'Mega Power Project Policy' of the Government of India.

NCEL has retained the services of "Infracon" to prepare this detailed project report for the installation of a 4 x 660 MW coal fired supercritical thermal power plant at Athiyakurichi, Kulasekarapattinam, Udangudi Villages in Tuticorin District, in the State of Tamil Nadu.

This report highlights the details of the site, availability of fuel and water, evacuation of power, features of the main plant equipment including sea water supply and cooling water systems, fuel supply systems, ash handling and disposal system, electrical systems, environmental aspects, estimates of project cost, cost of energy generation and schedule for project implementation.

1.2 POWER DEMAND SCENARIO

Based on the details of load forecast and assessment of generation capacity and duly taking into account the realistic planned additions to the grid and the assistance from the plants in the Southern region, it is anticipated that deficit in southern region during the financial year 2013-2014 is of the order of 5967 MW for generation capacity and 19878 MU for energy requirements. This deficit is expected to increase in the subsequent years if projects that are planned are not executed in time. With the projected GDP growth in excess of 8% p.a., the increase in the power generation need to be in excess of 12%, to cater to the demand of both industry, manufacturing and services sectors and to cater to the growing demand from the households. A sure sign of development is the per capita consumption of electricity and the country has been sadly lagging behind both the developed and the developing nations in the same. There is also

a lot of latent demand that has not surfaced due to the lack of quality power being transmitted to the villages. The Accelerated Power Distribution Program aims at reducing the Transmission & Distribution losses. This would manifest itself in new and improved implements being utlised which require a lot of power. Hence, installation of 4 x 660 MW thermal power plant at Kulasekarapattinam Village, Toothukudi District in Tamil Nadu State would help to mitigate the power and energy deficit

1.3 LOCATION

The proposed site is located around the villages Kulasekharapattinam, Athiyakurichi, Udangudi in Tuticorin Dist, Tamilnadu. The identified site area is nearly 1700 acres. There is no village / hamlet located inside the proposed site area. The land is scrub land or having coconut plantations (low yield). The vicinity map is enclosed as Annexure

1.4 TYPE OF PLANT

The proposed project comprises of Four (4) units of 660 MW with gross capacity 2640 MW. A blend of Indigenous coal (70%) and imported coal (30%) is envisaged as the main fuel for the station. The plant will be designed for base load operation with a plant design life of minimum 25 years. Super critical pressure steam cycle technology is considered for the electricity generation. Open recirculation cooling water system with Natural draft cooling towers is envisaged for plant cooling water system.

1.5 WATER SOURCE

Nearly 6,27,000 M^3/ day of water is required for 4x660 MW units. The required water would be drawn from Bay of Bengal which is 2 km from the project site. Necessary pump house and the cross country pipe line would be constructed.

1.6 ACCESS TO SITE .

The selected site is easily accessible by road. The site is located 15 km south of Tiruchendur town and is about 0.6 km from state highway (East Coast Road). The nearest railway station is Tiruchendur located at about 15 km from the site on southern railway. The nearest airport is Tuticorin which is about 55 km from project site.

1.7 PROJECT COST

The preliminary project cost works out to Rs. 13385 crores excluding interest during construction and financing charges. i.e., Cost per mw of installed capacity works out to Rs 5.07 crores. Rs 15154 crores including interest during construction and financing charges and considering all taxes and duties. i.e., Cost per mw of installed capacity works out to Rs 5.74 crores.

The cost of generation for first year of commercial operation after stabilization of the 4 x 660 MW units at station bus bar, after allowing for auxiliary power consumption and considering a minimum return of 15.5% on equity portion, works out to Rs. 3.22/ kWh. The Project Cost Estimates include all expenses to be incurred towards the entire project development including Site Development Expenses, Payments to EPC Contractor, Non EPC Expenses, Pre-Operating Expenses, Start-Up Fuel & Commissioning Expenses, Contingency and Financing Expenses including Interest During Construction (IDC).

The detailed Project cost is enclosed as Annexure.

1.8 PROJECT COMPLETION SCHEDULE

It is envisaged that the first unit would be put in to commercial operation in about 42 months reckoned from the zero date i.e, the date of award of the Letter of Award (LOA) for BTG package. Subsequently, the other units will be put into commercial operation with an interval of 6 months for each unit.

1.9 POWER PLANT RATING, CAPACITY, AVAILABILITY, PLF

Two power plant units are being planned for establishment in this project. Unit rating (on a Gross Basis) will be 660 MW at generator terminals based on the following site conditions. Super critical pressure steam cycle technology selected for the power station.

- **Ambient air temperature: Maximum dry bulb temperature of 36°C and minimum dry bulb temperature of 16°C and Relative Humidity of 71%.**
- **Condenser cooling water inlet temperature of 33°C and 9°C temperature rise across the condenser.**
- **Generator power factor of 0.85.**
- **Design temperature for electrical equipment of 50°C.**

The VWO capacity of the Steam Turbine will be around 105% of MCR and the Steam Generator Maximum Continuous Rating (BMCR) will be established to match the steam requirement at VWO conditions and other auxiliary steam requirements. The capacity of the unit is selected so as to deliver the rated output even after ageing that will occur between overhauls, as a result of deposition of salts in turbine blades, wear and tear etc.

The Plant Load Factor (PLF) being considered is 85% and plant availability up to 90% is considered.

1.10 ENVIRONMENT COMPLIANCE

Suitable provisions will be made in the plant design to comply with the prevailing environmental norms and regulations. Environment Impact Assessment (EIA) studies will be carried out at the beginning of the project work, to identify the impact of the proposed power project on the flora, fauna, human inhabitations, etc. in the surrounding area and prescribe mitigation measures. Suitable measures will be adopted to reduce generation of effluent and its full utilization within the project premises. The chimney height would be 275 meter as per environmental norm. Space provision in plant layout will be made for adding Flue Gas Desulphurization (FGD) plant.

Ash Utilization Plan for the proposed Project will be developed in line with the requirements of MOEF notification. Action plans for full utilization of ash, including the utilization in the cement and other industries will be implemented. Sufficient ash storage pond is also planned in the project site area to dump the excess ash. Necessary green belt would be created along the site boundary.

1.11 POWER EVACUATION

Technical requirements of power evacuation from the proposed power plant will be decided by the grid authority. It is proposed that power will be evacuated at 400kV. The power delivery point will be firmed up based on the transmission study by grid authority. The total power generated from the power plant will be 2640MW. After meeting the power requirement about 180 MW for the station auxiliaries, 2460MW will be available for export. Generated power will be stepped up to 400kV level by using step up generator transformers. To enable power evacuation, a 400kV outdoor air insulated switchyard with one and half breaker arrangement will be provided.

1.12 CONCLUSION

Adequate land for the project has been identified near Athiyakurichi, Kulasekarapattinam, Udangudi villages in Tuticorin Dist, Tamilnadu.

For the projected future power demand scenario in India especially in the Southern India and State of Tamilnadu, installing a Power Plant of 4x660 MW capacity close to water source, port , power grid and with existing infrastructure, etc., is considered to be economically viable. The plant concept and the technical features of the selected plant and equipment are latest and proven coal based power generation technology.

2

Necessity and Justification of the Project

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2.0 NECESSITY AND JUSTIFICATION OF THE PROJECT

2.1 INTRODUCTION

The power demand in India is increasing continuously due to rapid industrial and infrastructure developments. The capacity addition at the present rate will not be able to meet the projected demand and would result in a huge power deficit. To mitigate the gap between demand and supply, Govt. of India is facilitating large scale capacity additions at shorter time through public and private investments. To enable larger participation by private sector, the concepts of merchant power and power trading have been introduced.

With a view to participate and benefit from this initiative, NC Energy Ltd have proposed to construct and operate a 4 x 660 MW TPP near Athiyakurichi, Kulasekarapattinam, Madhavankurichi, Udangudi villages, Tuticorin Dist, Tamilnadu State.

2.2 PRESENT POWER SECTOR POSITION IN INDIA

Over the years, the Electricity Industry has made significant progress, Installed capacity increased from 1700 MW (1950) to 169748 MW (31st December-10) annual per capita electrical energy consumption increased from 16 kWh/annum (1950) to over 733 kWh/annum (2009). The present growth rate in power generation is about 6%.

Actual Power Demand Vs Supply Position in India

Year	Demand (MW)	Supply (MW)	Deficit (%)
2002-03	81492	71547	12.2
2003-04	84574	75066	11.2
2004-05	87906	77652	11.7
2005-06	93255	81792	12.3
2006-07	100715	86818	13.8
2007-08	108866	90793	16.6
2008-09	109809	96685	12.0

Source: Central Electricity Authority

Installed Capacity in India

Type	Installed Capacity (MW)
Hydro	37367.40
Coal	92378.38
Gas	17456.35
Diesel	1199.75
Nuclear	4560.00
Renewable	16786.98
Total	**169748.86**

Source: Central Electricity Authority-31.12.2010

All the three sectors namely Central, State and Private contribute to the availability of power in the country. State owns a share of about 50%, Centre own a share of about 32% of installed capacity and the rest by private sector. Major contribution of energy came from coal based thermal followed by hydel energy. The contribution of private sector in power generation has been increasing at a far greater pace, after de-licensing of the sector and liberalisation and globalisation.

The installed generating capacity has increased by more than hundred folds, annual electricity generation by more than ninety folds and annual per capita consumption of electricity by more than forty folds in the last 50 years. The size and expansion of transmission and distribution network has also increased substantially over the years. Despite the advent of new technologies, it is the transmission and distribution losses, that are at present at an unacceptable 23-25% range that are a cause of concern. It is also seen that the thermal power plant (coal based) capacity addition in the past vary from 3200-4300 MW per annum to meet growing demand.

As per the "5th National Power Plan (2002-2012)" prepared by CEA, a need based installed capacity of the order of 2,12,000 MW is required by the end of 11th plan based on demand projections of 17th Electric Power Survey. The primary resources for electric power generation are hydro, fossil fuel (coal, lignite, oil and natural gas) and nuclear energy. These would continue to serve as major sources of power generation in the long run, though various forms of renewable sources viz, wind, bio-mass, tides, etc., will also contribute to meeting the demand.

Plan	Year	Target (MW)	Achievement (MW)
10th	2002-2007	41110	21180
11th	2007-2012	78577	Under Progress

Based on the report of the Working Group on Power constituted by Planning Commission, a capacity addition of 41110 MW was targeted in 10th plan comprising 14393 MW of hydro, 25417 MW of thermal and 1300 MW of Nuclear. Out of the total thermal capacity of 25417 MW, the coal/lignite based capacity was to be 20053 MW.

As per Central Electricity Authority's (CEA) projection for the 11th Plan (2007-2012), the capacity addition requirement is 78577 MW comprising of 16553MW of hydro, 58644 MW of thermal and 3380 MW of nuclear. Out of the total thermal capacity of 58644 MW, the coal/lignite based capacity shall be 52905 MW. This implies that the capacity addition has to be about 10600 MW per annum through coal/lignite alone. Of these, the Ministry of Power has revised the estimates that only 55,000 MW is achievable.

The 11th five year plan calls for an additional 15000 MW to 16000 MW of power per annum, more than twice the figure achieved in each of previous years. The 11th five year plan program is comparatively large so as to provide not only for normal growth during the 11th plan period but also to compensate for shortfall in the capacity addition during the 10th plan period.

With the capacity addition of 41110 MW targeted for the 10th plan and 78577 MW assessed as required during the 11th plan, the capacity addition requirement during the 12th plan will be about 153000 MW. This will comprise of 47190 MW of hydro, 15160 MW of nuclear and 90615 MW thermal. The coal based capacity required will be about 83000 MW during the period 2012-2017. Any shortfall in achieving hydro capacity addition would also have to be made good by additional coal based projects. The shortfall of both the 10th plan and the 11th plan are also expected to be met during the 12th plan.

Keeping in view the huge power generation capacity requirement to be added during the 11th and 12th Plan periods, a rapid capacity addition through a large scale thermal power development programme is planned.

2.3 POWER SUPPLY AND DEMAND POSITION IN TAMILNADU AND SOUTHERN REGION

For the purpose of power planning and operation of the regional grid the Southern region consists of the following states:

- Andhra Pradesh
- Tamilnadu
- Kerala
- Karnataka
- Pondicherry

All the three sectors namely Central, State and Private contribute to the availability of power in the Southern region. Coal based power plant occupy more than 73% of installed capacity in this region, due to non availability of perennial rivers and mountainous terrain that can support major hydro electric projects.

Even though major portion of generated power from this power project would be consumed by Tamilnadu state, it is proposed that the remaining power would be sold to power deficit states in the Southern region after meeting local demand.

2.3.1 Present Power Scenario

The power scenario i.e. installed capacity & actual power supply position in Tamilnadu state & Southern region are given below.

2.3.1.1 Andhra Pradesh

Installed Capacity (MW)

S.No	Sector	Hydro	Thermal	Nuclear	R.E.S.	Total
1	Private	0	2915.20	0	530.76	3445.96
2	State	3695.53	4592.50	0	190.83	8478.86
3	Central	0	2377.38	214.28	0	2591.66

Total Installed Capacity as on 31.03.2010 is 14516.48 MW

2.3.1.2 Karnataka

Installed Capacity (MW)

S.No	Sector	Hydro	Thermal	Nuclear	R.E.S.	Total
1	Private	0	1786.50	0	1842.94	3629.44
2	State	3599.80	2347.92	0	594.55	6542.27
3	Central	0	1072.67	195.36	0	1268.03

Total Installed Capacity as on 31.03.2010 is 11439.74 MW

2.3.1.3 Kerala

Installed Capacity (MW)

S.No	Sector	Hydro	Thermal	Nuclear	R.E.S.	Total
1	Private	0	195.84	0	0.03	195.87
2	State	1881.50	234.60	0	142.83	2258.93
3	Central	0	1124.96	78.10	0	1203.06

Total Installed Capacity as on 31.03.2010 is 3657.86 MW

2.3.1.4 Tamilnadu

Installed Capacity (MW)

S.No	Sector	Hydro	Thermal	Nuclear	R.E.S.	Total
1	Private	0	1164.76	0	5130.04	6294.80
2	State	2122.20	3493.20	0	85.55	5700.95
3	Central	0	2299.81	478.50	0	2778.31

Total Installed Capacity as on 30.06-2009 is 14774.06 MW

2.3.1.5 NLC

Installed Capacity (MW)

S.No	Sector	Hydro	Thermal	Nuclear	R.E.S.	Total
1	Private	0	0	0	0	0
2	State	0	0	0	0	0
3	Central	0	100.17		0	100.17

Total Installed Capacity as on 30.06-2009 is 100.17 MW

2.3.1.6 Pondicherry

Installed Capacity

S.No	Sector	Hydro	Thermal	Nuclear	R.E.S.	Total
1	Private	0	0	0	0.3	0.3
2	State	0	32.50	0	0	32.50
3	Central	0	207.01	16.28	0	223.29

Total Installed Capacity as on 31.03.2010 is 255.82 MW

2.3.1.8 Overview of Southern Region

Installed Capacity (MW)

S.No	Sector	Hydro	Thermal	Nuclear	R.E.S.	Total
1	Private	0	6062.30	0	7503.79	13566.09
2	State	11299.03	10700.72	0	1013.76	23013.51
3	Central	0	8249.58	1100	0	9349.58

Total Installed Capacity as on 31.03.2010 is 45929.18 MW

2.3.2 Future Power Demand

CEA has made projections for the future demand of power in Tamilnadu State (as per 17th EPS) and the same is compared with actual as follows:

YEAR	PEAK LOAD-MW		ENERGY-MU	
	Requirement as per 17th EPS	Actual Demand	Requirement as per 17th EPS	Actual Requirement
2004-05	8215	8215	51449	50985
2005-06	9420	9420	55479	54698
2006-07	10090	10090	59824	58972
2007-08	10807	10807	64510	63189
2008-09	11575	11575	69563	68476
2009-10	12398		75011	
2010-11	13280		80886	
2011-12	14224		87222	

Source: Report on 17th Electric Power Survey of India.

2.3.2.1 Tamilnadu

The future demand in the State and in the Southern region, up to 2021-22, as per the 17th Electrical Power Survey is given below:

Energy/Power	*Year*	*Tamilnadu*
Peak Demand (MW)	2011-12	14224.060
	2016-17	21975.660
	2021-22	29814.931
Energy Requirement (GWh)	2011-12	87221.910
	2016-17	134754.730
	2021-22	182825.156

The demand forecast for the Maharastra state as per the 17th Electrical Power Survey, Gov. of India.

2.3.2.2 Southern Region

Energy/Power	*Year*	*Southern Region*
Peak Demand (MW)	2011-12	40367.135
	2016-17	60432.580
	2021-22	80484.967
Energy Requirement (GWh)	2011-12	253442.990
	2016-17	380068.150
	2021-22	511658.908

The demand forecast for the Southern Region as per the 17th Electrical Power Survey, Gov. of India.

2.3.3 Capacity Addition Planned

To mitigate the supply and demand, likely capacity addition planned during the 11th plan five year plan period is about 21380.0 MW in the Southern region. This capacity addition planned comprises 1170 MW of hydro and 20210.0 MW thermal.

The rapid pace of all round developments of the states in the region due to globalization of economy has seen the states in the region to be a few of the highest power consuming states in the country. The power demand and availability figures of the states exhibit a wide uncovered margin calling attention of the planners to accelerate the pace of growth in this core sector. With the present trend of growth rate ranging around 7-9% for the past two decades, the concern of State Government in the region can be gauged from the urgency with which they are exploring all possible means of augmenting the generating capacity.

Sl.No	Power Position – Southern Region	Unit	Value
1	Present Installed Capacity	MW	45929.18
2	Present Peak Generation (Dec 2010)	MW	26974
3	Present Calculated Load Factor (2)/(1)	%	74.37
4	Power demand forecast at the end of 11th Plan	MW	47108
5	Expected Load Factor (worst)-Refer (3)	%	65
6	Estimated Installed Capacity required at the end of 11th Plan (4)/(5)	MW	72475
7	Planned capacity addition during 11th Plan	MW	21380
8	Deficiency at the end of 11th Plan (6)-{(1)+(7)}	MW	**869.97**

The power scenario in Southern Region during 11th five year Plan is discussed in detail and need for the proposed station is studied in this section in the back drop of past and future power demands: viz:, present and future generation capacities planned for bridging the gap. In order to narrow down the bridging gap between supply and demand, an urgent need is felt for a large scale thermal power development programme in an environment friendly manner.

2.4 CONFIGURATION & JUSTIFICATION

The power demand-supply scenario in the region during 11th & 12th five year plans as described above highlights the need for setting up a large capacity plants to match the demand in short time. It is therefore proposed to set up a 4 x 660 MW thermal power plant in Tamilnadu which will not only cater to the Tamilnadu state but will also be utilized for supplying power to the power deficit Southern region and India. The location being close to the sea, sea water is available for the power plant. Indigenous coal (70%) blended with imported coal (30%) from Indonesia is considered as the fuel. Further, well developed infrastructure facilities are readily available in the near proximity to the Site. Taking all these into consideration, establishment of the proposed coal based Power Plant of 4 x 660 MW at this location is well justified.

2.5 CONCEPT OF MERCHANT POWER

The Union Power Ministry is encouraging merchant power plants across the country as a means to create additional generating capacity at a faster rate through private sector participation.

Merchant power is the term used by power companies to describe electricity sold in the open market. Power plants usually sign long-term power purchase agreements (PPAs) with state governments under which they agree to sell power to state-owned distribution utilities at a fixed rate for a specified period.

Merchant power plants will cater to different uses in the market – to supply electricity regularly to the grid or to meet peak loads. They will not have long-term power purchase agreements with a single buyer. Instead, they can commit a certain percentage of their capacity to such agreements and sell the balance generation in the open market to licensed power traders who need the power at that particular time.

The Electricity Act, 2003 recognized the concept of trading as a distinct licensed activity and CERC is identified as the regulator. CERC have issued guidelines for trade licensing, power trading and for setting up power exchanges. CERC have issued power trading licenses to many trading companies and setting up of power exchanges is in the process.

To facilitate sale of power to power traders and third parties, the government has established an open access policy in power transmission. Introduced in the Electricity Act, 2003, open access basically refers to the right to transmit power over a system belonging to a third party. CERC have laid down procedures open access in distribution. SERC of many states have followed up by laying down of provisions for open access. Limited power flow on open access basis has already started.

With such concerted efforts in all areas, Merchant power is considered a favorable option for private sector.

Thus, in order to mitigate the growing power shortage in the region, which is going to be the automobile and manufacturing hub of South East Asia, and in order in order to aid in ambitious growth rate of 9% in GDP, in order to meet the latent demand from the growing middle class of the country that crave for supply of reliable, uninterrupted power, this project is envisaged.

3
Land Availability and Site Selection

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3.0 LAND AVAILABILITY AND SITE SELECTION.

NC Energy Ltd., (NCEL) has evaluated three alternate sites in Tuticorin and Ramnad districts of Tamilnadu from the environment angle. Out of the three sites evaluated, Site – 3 was found suitable from the environment angle conforming to the sitting guidelines of Ministry of Environment and Forests. The following are the three sites evaluated for the purpose of establishing the coal based thermal power plant.

SITE – 1 : NEAR VEMBAR
SITE – 2: NEAR ANAIKUDI

SITE – 3: NEAR ADAIKURICHI VILLAGE

The justification for selection of Site – 3 is given below:

SITE-1 Near Vembar village.

The site is scrub land. About 1400 acres of land is available. There are no habitations on the site. However, discussions with the Gulf of Mannar Biosphere Reserve authority had revealed that obtaining the No Objection Certificate will be difficult. Hence the site was not selected.

SITE-2 Near Anaikudi village.

The site is near Anaikudi village. About 1400 acres of land is available. The land is predominantly scrub land with palm trees. There is no habitation on the land. Detailed verification of the land records had revealed that the documentation is not proper and hence the site was rejected.

SITE – 3: Near Adaikurichi Village.

The site is near Adaikurichi village. The land is scrub land with coconut trees. Due to water scarcity, the yield of the coconuts is also very low. About 1700 acres of land is available. There are no habitations on the land. There is a river in the southern side joining the sea. The sea is at a distance of 2 km.

3.1 LOCATION AND ACCESS

3.1.1 Location

The proposed site falls under the revenue limits of Adaikurichi, Kulasekharapatnam and Udangudi, Tiruchendur Taluk, Tuticorin District, Tamilnadu.

3.1.2 Access.

The site is well connected to Tuticorin and Tiruchendur. The ECR highway also passes close to the site. Tuticorin Port handles coal cargo which will be utilized for this Project also. Two options namely Jetty, or transporting coal from Tuticorin will be studied.

3.1.3 Current Usage, Land Classification & Topology

The proposed site comprises scrub and coconut plantations. This is primarily due to non availability of water. The identified land required for putting up the proposed project will be purchased from private owners.

The site surrounding area is scarcely populated and there is no dwellings in the proposed site area. The identified land will not have any rehabilitation and resettlement (R&R) issues.

Topography of the proposed site is more or less flat. Major filling/cutting works are not anticipated, since the plant layout will be made in such a way that the natural topo will be utilized to the extent possible. However trees/bush/grass growth shall have to be removed. No major HT lines are passing through the proposed site. Preliminary works such as topography survey and soil investigation study are to be conducted at the proposed site. Natural drainage facility is available in the site and will be suitably marked after the topography survey, based on the slope, for drainage. Foundation for power house building, main structures shall be based on geotechnical report.

3.2 SITE SELECTION

The following factors which influence the site selection have been very favorable to select this site.

a. Nearness to sea and well connected to port.
b. Availability of reliable & adequate cooling water from Bay of Bengal at 2 km distance
c. Availability of adequate land for locating the power plant with approach roads.
d. Suitability of land from topography aspect

e. Proximity of State Highway for transport of fuel & heavy equipments.

f. Facility for interconnection with transmission system for evacuation of power.

g. Environmental aspects.

h. Availability of infrastructure facilities.

i. No national park is located in nearby vicinity.

DESCRIPTION	4 X 660 MW (AS PER CEA) PRO-RATA	**NC ENERGY LTD PROPOSED (ACRES)**
MAIN PLANT AREA	40	**50**
COAL HANDLING PLANT	80	**80**
WATER (IDCT) (NDCT)	72 120	**85**
SWITCHYARD	37	**50 (765kV)**
BALANCE OF PLANT	88	**100**
SUB TOTAL	**317**	**365**
GREEN BELT	105	**125**
ASH POND	**147**	**500**
TOWNSHIP	150	**150**
CORRIDOR FOR WATER AND COAL	150	**150**
TOTAL	**869**	**1290**

The selected site is located nearer Bay of Bengal, and hence adequate sea water is available. Since the site is located not far from the sea, the fuel will be transported to the plant directly through conveyor from the port. The site is located near to the Highway.

Adequate land required for putting up the proposed plant will be taken on outright purchase basis from private owners / local farmers.

3.3 EXTENT OF LAND REQUIREMENT

The plot consists of total area of 1300 acres. The actual requirement for 2640MW power generation plant in a coastal area will require about 1200 acres. In the present case about 1300 acres will be utilized for setting up the power plant. The ash pond of about 500 acres is provided since blended fuel is contemplated to be used.

The land for Township &corridor will be acquired after completion of detailed survey. The ash pond area identified (500 acres) is adequate to dump the surplus ash in first four years of plant operation. If additional land is required for dumping ash after four years of plant operation, same will be acquired in the vicinity of power station in future.

3.4 FEATURES OF SELECTED SITE

3.4.1 Water

3.4.1.1 Raw Water

The plant water requirement is proposed to be met from the Bay of Bengal which is at a distance of 2.0 km. It is planned to have a jetty for unloading the coal and transporting the same by means of pipe conveyor to the site.

3.4.1.2 DM Water

The treated Water to cater the plant needs such as boiler make-up, station services, drinking water, etc., shall be fed from a water treatment plant for the proposed plant.
A detailed water balance is given in **Annexure - 3.**

3.4.2 Fuel

It is proposed to use Blend coal comprising 70% indigenous coal and 30% imported coal. The details are enclosed in **Annexure – 4.**

3.4.3 Power Evacuation

The total power generated from the power plant will be 2640MW. After meeting the power requirement about 180 MW for the station auxiliaries, 2460MW will be available for export. Generated power will be stepped up to 400 / 765kV level by using step up generator transformers. To enable power evacuation, a 400 / 765kV outdoor air insulated switchyard with one and half breaker arrangement will be provided.

Technical requirements of power evacuation from the proposed power plant will be decided by the grid authority. It is proposed that power will be evacuated at 400/ 765kV. The power delivery point will be firmed up based on the transmission study by grid authority.

3.4.4 Topographical and Geological Aspects

Topographical survey of the area indicating the spot levels, contours and permanent features will be conducted at the site.Topography of the proposed site appears even and flat, major filling/cutting works are not required. Foundation for power house building, main structures shall be based on geotechnical report. It is expected that bed rock is available at 10mts depth in this area.

3.5.6 Ecological Impact

There is no problems of displacement of population and no related impacts will be applicable for the site as the proposed site is under the control of private land owners and fully vacant. The site development will consider the recommendation of the local authorities as well as the guidelines of MoEF. There is no rehabilitation requirement and resettlement issues (if any) shall be addressed during taking over of land for the project.

Ash Utilization Plan for the proposed Project will be developed in line with the requirements of MOEF notification. Action plans for full utilization of ash, including the utilization in the cement and other industries will be implemented. Sufficient ash storage pond is also planned in the project site area to dump the excess ash. Necessary green belt would be created along the site boundary.

Suitable provisions will be incorporated in the design of buildings, structures and selection of equipment such that there are no adverse effects due to emissions, noise, contamination of soil water and air. A detailed EIA study would be conducted to assess the impacts and the recommendations will be followed while establishing the project.

4
Fuel Source & Availability

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4.0 FUEL SOURCE & AVAILABILITY

4.1 SOURCE AND TYPE OF FUEL

4.1.1 Coal

Indigenous coal of E grade considered as main fuel for the proposed project. The indigenous coal will be sourced from coal mines of ECL from IB valley or Talcher mines located approx 1600 Km. In addition to the above source of indigenous coal, 30% imported coal of 4100 Kcal/ kg GAR shall be imported through Manappad port and would be transported to the site through closed loop coal conveyor system.

4.1.2 Start-up Fuel

The steam generator will be designed for cold start-up and initial warm-up using Light Diesel Oil (LDO)/ Heavy Fuel Oil (HFO). HFO/LDO will be received to the proposed plant by means of the rail/road tankers.

4.2 COAL LINKAGE AND MODE OF TRANSPORTATION

The Indigenous coal from the coal mine to the proposed site shall be transported through Indian railway networks to Paradeep Port and from thereon by ship to Manappad port. Necessary coal linkage would be obtained for transporting coal from the identified mines

4.3 ANNUAL FUEL REQUIREMENT

Coal

The annual requirement of coal is given below:

Parameter	Unit	IMPORTED COAL	INDIAN COAL	BLEND COAL
GCV of coal	Kcal/Kg	4100	3800	3890
Station Heat rate	Kcal /KWhr	2300	2300	2300
Coal required at 85% PLF	MTPA (Million Tons per Annum)	10.96	-	12.13

Startup Fuel

Fuel oil consumption for the proposed project shall be about 20,000 kl / annum by considering 1 ml / KWhr and plant load factor of 85%.

5

CAPACITY AND TYPE OF PROPOSED PLANT

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5.0 CAPACITY AND TYPE OF THE PROPOSED PLANT

5.1 Selection of Steam Parameters

The proposed 660 MW unit will have super critical steam parameters to achieve higher efficiency and hence, lower cost of generation. The review of parameters followed for units of comparable sizes indicates that typically steam parameters in the following range have been adopted world wide:

Table – 5.1

Parameter for Supercritical Boiler

Parameters	Value
Main Steam at turbine inlet	
Pressure, bar	239 – 300
Temperature, °C	540 – 600
Hot Reheat Steam	
Temperature, °C	565 – 620

The primary factors, which govern the steam cycle selection, are unit availability and proven operating performance - efficiency, equipment cost and the fuel price. With higher steam parameters, the investment cost goes up on account of increase in the cost of boiler and turbine island equipment. However, on account of higher plant efficiency, the incremental investment cost is recovered within the initial years of operation.

The other major benefit of adopting higher steam cycle is reduction in emissions (SPM, C02, S02, NOx). Secondary benefits of higher steam cycle parameters are reduction in the capacities of auxiliary systems such as cooling water, coal and ash handling, thus resulting in some savings in the capital cost.

5.2 Type of the Proposed Plant

For the planned capacity of the generating station, the following standard configuration can be adopted;

A plant configuration of 4x660 MW with pulverized fuel fired boilers to be executed has been considered for the purpose of this Prefeasibility Report.

5.3 Brief update on Supercritical Technology

The advancement in metallurgical research coupled with rising fuel prices have contributed to the migration of the manufacturers and the project developers to higher steam parameters. Some of the supercritical power plants of comparable parameters are listed below:

Table – 5.2

List of some Supercritical Boilers Installation

S.No	Plant	Year of commissioning	Capacity (MW)	*Steam Parameters Pr./SH Temp/ HRH Temp
1.	Yuhuan, P.R.China	**2008	2x1000	250 / 600 / 600
2.	Torrevaldaliga, Italy	2006	6x660	250 / 600 / 610
3.	Yong Hung Unit 1&2 South Korea	2004	2x800	255 / 569 / 569
4.	Hitachi – Naka No. 1, Japan	2003	1000	250 / 600 / 600
5.	Tokyo Electric Co., Hitachi Naka, Japan	2003	1000	250 / 600 / 600
6.	Niederaussem, Germany	2002	1000	275 / 580 / 600
7.	Niederaubem, Germany	2002	950	250 / 580 / 600
8.	Avedore, Denmark	2001	450	300 / 580 / 600
9.	Lippendorf, Germany	1999	2 x 933	267 / 554 / 583
10.	Nordijyllaend Unit 3, Denmark	1998	410	290 / 582 / 580
11.	Matsurra, Japan	1997	1000	246 / 593 / 593
12.	Schwarze Pumpe, Germany	1996 / 1997	815	262 / 547 / 565

* Main Steam Pressure in bar, Main Steam and Reheat Temperature in deg C respectively.

* * Yet to be commissioned.

In India, presently there is no supercritical thermal power plant in operation. NTPC is currently building the 3 X 660 MW supercritical thermal power plant at Sipat, Steam parameters for which are 250 bar / 540°C / 565°C. For the ultra Mega Power Projects, Which are under active consideration by Government of India, the minimum steam parameters are 242 kg/cm^2 (abs) / 535°C / 565°C.

Keeping in view the current technological trend in the supercritical units, recent international power projects, the cost of coal (and its possible escalation during the plant life), number of manufacturers available in the world as well as projected investment cost, following steam cycle parameters (at the inlet of TG ESV) are proposed for the Project:

- Pressure : 247 bar
- Main steam temperature : 565 °C
- Hot Reheat temperature: 593 °C.

6

SALIENT FEATURES OF THE PLANT

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6.0 SALIENT TECHNICAL FEATURES OF THE PLANT

6.1 Plant Layout

A preliminary general plant layout is shown in the plot plan attached as Annexure of this report indicating the tentative layout considering a plant configuration of 4 x 660 MW of the power station. This layout will be suitably modified, when actual plant site boundary is made available from the project company.

A conventional layout has been proposed for the plant and the switchyard. Proposed switchyard is in front of the turbine house. Boiler and electrostatic precipitators and chimneys are at the back of the turbine house.

Coal storage and handling facilities have been located behind chimney. At present Coal stockpile for 30 days requirement has been envisaged within the plant, considering long-distance of coal source.

Water treatment plant facilities, cooling towers, water treatment plant along with other infrastructure facilities are proposed to be located around the main plant.

Other off-site facilities are located considering their functional, operation and maintenance convenience and applicable statutory requirements. Space provision has been kept near chimney for installation of Flue Gas De-sulphurization (FGD) system as per the environment guidelines. A 50 M corridor around the plant boundary for green belt development has also been considered. The exact location and width of green belt shall be decided after the full EIA study.

6.2 Mechanical Equipment and System Design

6.2.1 Steam Generator and Auxiliaries

a) General

The Steam Generator (SG or Boiler) will be once through, pulverized coal fired, single re-heat, balanced draft, outdoor type with membrane tube construction. The configuration / arrangement of the SG will be as per the standard proven design of a leading manufacturer with all necessary auxiliaries having the following features:

o High efficiency

o High availability

o Low auxiliary power consumption

o Low emissions

o Short start-up times

o Quick load following capability

The SG is proposed to use domestic coal as main fuel (GCV 3200 kcal/kg; ash 40 %) for design. The exact design criteria shall be laid down during bidding stage.

Indicative Main parameters for the Steam Generator condition are given in the following Table:

Performance Parameters Table - 6.1

Parameter	Unit	Value
Main Steam Flow at BMCR	Tones per hour	2105
Main Steam Flow at TMCR	Tones per hour	1966
Main Steam at SH Outlet		
Pressure	Kg/cm2 (a)	257
Temperature	°C	571±5 or higher
RH Outlet		
Temperature	°C	597±5 or higher
Final feed water temperature	°C	290±5
Condenser back pressure	Kg / cm2	0.09 to 0.102

Boiler design shall also be suitable for variable pressure operation from 40% to 90% BMCR with 5% throttle margin.

The overall arrangement for the steam generator will incorporate the following main aspects:

The steam generator will be designed for outdoor operation arranged in the form of a self-contained construction with integrated boiler house roof.

At the rear of the boiler two sets of regenerative air pre heaters will be arranged with vertical flue gas ducts so as not to allow fly ash accumulation. Four electrostatic precipitators will be located downstream.

The mills and bunker bay will be arranged on the front or rear side of the boiler, as per the proven design of the manufacturer.

Air and flue gas systems will be arranged in two-line design.

Simple air system arrangement with single secondary air collecting duct and symmetrically arranged air ducts to the burners is envisaged.

2x 60 % capacity axial Forced Draught (FD) fans and 2x 60 % capacity axial Induced Draught (ID) fans will be provided with a proven type variable blade pitch control offering high efficiency. ID fans of radial type with variable frequency drive may also be considered based on the proven standard design of the boiler supplier. The FD fans / ID fans will be designed based on the coal with the highest air requirement and flue gas volume respectively. In addition, for the design of the ID fan the expected air leakage of the air heater during operational cycle will be considered.

- The boiler soot blowers will be arranged on both sides and will be placed on platforms, which will be suspended from the boiler structure.

c) Steam Generator Circulation System

The water and steam flow boiler arrangement will have the following characteristic features:

- Furnace walls acts completely as evaporator, with even heat absorption and even pressure loss equality for each pipe, resulting in minimized temperature differences at evaporator outlet.
- Furnace platen as first super heater heating surface of self-cleaning membrane wall plates with appropriate lateral spacing.
- Optimized heating surface distribution and arrangement, thus excellent temperature control in conjunction with the two stage spray at temperature stations for all loads.
- Lowest temperature and enthalpy differences in the heating surfaces.
- Start-up system for 30 - 40 % Supercritical once through minimum load

Soot blowers arrangement within the combustion chamber (furnace) and heating bundles, offering selective cleaning capability.

d) Air and Flue Gas System

A balanced draft system will be provided. There will be two axial FD fans and two radial or axial ID fans. Two (2) pairs of regenerative rotary type tri-sector air pre-heaters will be provided for primary air and secondary air system. Suitable arrangement will be provided for start-up, low load operation or abnormal conditions when an increased air inlet temperature is considered desirable to minimize the cold end corrosion of regenerative air pre-heaters.

e) Chimney

For 4 x 660 MW units, two no's twin flue chimney is envisaged. The chimney height shall be 275 meters.

f) Fuel Oil System

Start-up is by LDO/HSD, warm up and low load (up to 30%) carrying shall be done by heavy furnace oil HFO/ HPS/ LSHS. Boiler will be so designed that oil firing for flame stabilization will not be required beyond 40% MCR. Necessary pumps, filters and heaters shall be provided. The burners, air registers etc. will have independent pneumatic drives and the entire operation of purging, insertion, air and fuel sequencing removal and blow off shall be automatic. Ignition of heavy oil shall be directly by high-energy arc igniters. There shall be light oil (LDO) firing in at least in one burner elevation having a minimum capacity of 7.5% BMCR to facilitate a cold start up of the unit when no auxiliary steam is available for HFO heating and atomization. LDO system shall be sized for 7.5% BMCR capacity for each boiler.

g) Coal Burning System

The coal burning system will comprise of roller mills. The number and capacities of the mills shall be so selected that while firing the worst and design coal at BMCR, the following spare capacities shall be ensured.

1. With 90% loading of the working mills, at least one mill will be spare at 100% BMCR while firing the worst coal.
2. With 90% mill loading of the working mills, at least two mills will be spare while firing the design coal at 100% BMCR.

Coal from raw coal bunkers will be fed into the mills by gravimetric coal feeders suitable for handling moist coal. There will be two PA fans for transporting the pulverized coal from mills to burners.

h) Soot Blowing System

Fully automatic, sequentially controlled, microprocessor based steam soot blowing system, complete with provision for individual operation of any soot blower pair and facility to by pass any soot blower, will be provided. The system will have short retractable rotary wall blowers for the furnace and long retractable rotary blowers for the furnace and long retractable rotary blowers for the superheater, reheater and economizer.

i) Auxiliary Steam System

Each of the unit will be provided with suitable and efficient Auxiliary steam distribution system. PRDS stations, depending on the station auxiliary steam requirement, are also envisaged. The unit will have its own auxiliary steam header whereas for station services a common station auxiliary steam header is also proposed. A high temperature station auxiliary steam header taking its tap off from the auxiliary PRD station before the de-super heater will also be provided to take care of the mill fire fighting and air heater soot blowing.

j) Elevators

Four (4) numbers passenger cum goods elevators of suitable capacity shall be provided one for each steam generator.

k) Electrostatic Precipitator

It is proposed to install high efficiency (-99.9%) electrostatic precipitators having an efficiency that limits the outlet emission to 50 mg/Nm3 below the value specified by PCB / MOEF, at BMCR with design coal firing and one series field out of service.

The electrostatic precipitators will have four (4) parallel gas streams, isolated from each other on the electrical as well as gas side and will be provided with gas tight dampers at inlet and outlet of each stream, so as to allow maintenance to be carried out safely on the faulty stream, while the unit is in operation.

Electrostatic precipitator will be provided with microprocessor based programmable type control system for transformer rectifier sets, rappers and ESP management system to ensure the safe and optimum operation of ESP. ESP transformer rectifier sets will use high fire point oil as the cooling medium. The dust collection hoppers at all strategic locations will have a minimum storage capacity of eight (8) hours. The hoppers will have heating arrangements to prevent ash sticking to the sloping sides and down pipes. Level indicators to indicate and trip the ESP in case of high ash levels in the ash hoppers, which will jeopardize the safety of ESP otherwise.

l) Provision of future installation of Flue Gas Desulphurising (FGD) System

Separate SOx removal system ahead of the stack in the flue gas path is not envisaged at this stage due to less Sulphur content in the coal. However, as per the guidelines of MoEF, space provision will be kept for installation of FGD at a later date should statutes warrant for the same. The design and layout of steam generator and its auxiliaries will be such that a wet/dry flue gas desulphurisation system can be installed in future, taking suction from duct after ID fan and feeding the desulphurised flue gases back to the chimney with provision for bypassing the FGD system. Also space will be kept for the provision for lime storage, handling and feeding the FGD system.

m) Chemical Dosing System

High pressure chemical dosing system complete with preparation and metering tanks 2x100% dosing pumps, connecting piping, valves and fittings will be provided to control the quality of water at the steam generator.

n) Environmental and Efficiency Considerations

In order to meet the environment norms and maintain the sustained efficiency of ESP, it shall be adequately designed with sufficient margins for all operating conditions. The Electrostatic Precipitator Management System (EPMS) in conjunction with opacity monitor shall continuously monitor and maintain the optimum energy level to achieve higher efficiency and availability of the boiler. Combustion system shall be designed for low NOx formation by adopting the appropriate burners, high efficiency at part load, flexibility to burn coal within the range specified, quick start up.

6.2.2 Turbine and its Auxiliaries

a) Turbine

The steam turbine shall be tandem compound, single reheat, regenerative, condensing multi-cylinder design with separate HP, separate IP or combined HP-IP and separate LP casing(s) directly coupled with the generator suitable for indoor installation. The plant would be designed to operate as a base load station. However, continuous operation under two shift and cyclic modes during certain periods of the year is also envisaged. The turbine design shall cover adequate provision for quick start-up and loading of the units to full load at a fast rate. Apart from constant pressure operation, the turbine shall also have the facility for sliding pressure operation. The turbine shall be provided with suitable margins for VWO flow.

b) Condenser

Single pass or double pass condenser of tubes welded type shall be adopted. The condenser shall be with divided water box construction. ASTM A312 TP-304 shall be condenser tube material. It shall be horizontal, surface type with integral air-cooling section. Condenser hot well shall be sized for three (3) minutes storage capacity (between normal and low level) of total design flow with the turbine operating a VWO condition, 3% make-up, and design backpressure. The condenser shall be adequately sized to cater to all the conditions of turbine operation including the abnormal operating conditions such that condenser would not be a bottleneck at any stage of operation. The exact condenser parameters shall be optimized on the basis of site data and most economical combination of cooling surface and circulating water quantity. The condenser shall be designed, manufactured and tested in accordance with the latest applicable requirements of the Heat Exchange Institute (HEI), USA. Provision of separate sponge rubber ball type condenser on-load tube cleaning system for each half of the condenser including ball circulation pumps, strainer, ball monitoring system etc. shall be made.

c) Air Extraction System

The unit shall comprise of (2x100%) vacuum pumps along with all accessories and instrumentation for condenser air evacuation. The vacuum pumps and accessories shall be used to maintain vacuum by removing air and noncondensable gases from steam condenser during plant operation. Vacuum pumps shall be of single/two stage liquid ring type with both stages (if two stage pump is selected) mounted on a common shaft. Vacuum pumps shall be sized as per latest HEI requirements.

d) Turbine Lubrication Oil System

The turbine generator shall have a complete self contained Lubrication Oil System. The system shall cater to the lubrication requirements of the bearings, requirements of turbine turning gear during start up and shut down and jacking requirements during turning gear operation. In addition, it shall also supply oil to the generator seals under emergency condition.

The system shall specifically include the following:

i) The main oil pump shall be centrifugal /gear type. The turbine shaft shall directly drive it. It shall have sufficient capacity to handle lube oil requirement of the bearings and emergency seal oil requirements.

ii) 1x100% AC auxiliary oil pumps for start-up, shutdown of TG unit and as standby to MOP for automatic operation. These pumps shall be in service during start up till the main oil takes over the supply.

iii) 1x100% DC emergency oil pump for meeting lube oil requirements of bearings during emergency, with automatic starting on low lube oil pressure preset value.

iv) One (1 x100%) each AC and DC motor jacking oil pumps shall be provided to lift the rotor at the bearing during turning gear operation.

v) The unit shall be provided with an oil tank of sufficient capacity to allow 5 to 8 oil changes per hour (at normal operating level), fitted with non-corrodable strainers, level indicators & necessary manholes. 2x100% duty vapor extraction fans driven by motors shall also be provided.

vi) 2x100% capacity oil coolers shall be provided for cooling the lubricating oil. The cooling medium shall be passivated DM water (condensate quality).

vii) A lube oil purification unit shall be permanently connected to the piping system for each TG unit for purifying 20% of the total oil charge in the system per hour on a continuous bypass basis. Each unit shall be complete, self-contained with centrifuge, explosion-proof motors, motor-driven feed pumps, heaters etc.

viii) A centralized lube oil storage and purification system consisting of a centralpurifier (capacity and type same as unit purifier) two central oil tanks (each withcapacity one and half times the capacity of one unit oil tank), transfer pumps (for dirty and clean oil) shall be provided. This is for storing and purifying oil from unit oil tanks and also for adding new oil to the system and also for transferring the fresh oil to the unit oil tank. In case of maintenance of the unit purification system, this system shall serve as a backup system.

e) **Turbine Control Fluid System**

For the governing and control system of the turbine a complete self contained control fluid system shall be provided. Fire resistant fluid shall be employed to minimize fire hazards. The system will comprise of:

i) A control fluid reservoir of adequate capacity to ensure fluid supply of acceptable purity.

ii) 2000% AC motor driven pumps to be connected to fluid reservoir along with hydraulic accumulators.

iii) 2x100% capacity control fluid coolers designed for service with DM water (condensate quality).

A control fluid purifying unit using Fuller's earth shall be provided for each turbo-set permanently connected to the piping system for purifying at least 2% of the total fluid charge in the system per hour on a continuous bypass basis. 2x100% capacity AC motor driven purification pumps to circulate oil through purification system are envisaged. Necessary filters, strainers, piping, fittings, valves and instruments shall be provided. All the components including piping which are coming in contact with the control fluid shall be of stainless steel.

f) **Gland Steam Sealing System**

A fully automatic gland sealing steam supply steam shall be provided for the main TG set and BFP drive turbine. HP and IP turbine shaft glands will be sealed to prevent escape of steam into the atmosphere and the LP turbine glands will be sealed for preventing leakage of atmospheric air into the turbine. Steam will be used for sealing these spring backed labyrinth glands.

During start up and low loads seal steam will be supplied to the turbine glands from the auxiliary steam header or cold reheat line through a seal steam regulating valve. During normal operation the HP and IP glands will be used for sealing the LP glands. The excess leak-off steam will go to the condenser. A gland steam condenser will be provided to condense and return to the cycle, all gland leak-off steam from TG set and from BFP turbines. A de-superheating type bypass shall be provided during outage of gland steam condenser. 2x100% capacity exhausters shall be provided to remove non-condensable gases from the gland steam condenser. The exhaust gases shall be left above the TG hall roof level.

g) **Governing/ Regulation Systems**

The turbine will have throttle or nozzle controlled type governing. The steam turbine generator unit shall be equipped with an electro-hydraulic governing control (EHGC) system backed up by 100% mechanical-hydraulic system. The governing system shall be highly reliable and operationally safe and it shall be capable of controlling with stability the speed of the turbine at all power outputs between zero and the specified maximum power output when the unit is operating isolated or the energy input to the steam turbine when the unit is operating in parallel with the other units. The turbine governing system shall be designed for high accuracy, speed and sensitivity of response. The governing system shall limit the over speed of the turbine on loss of full load to value less than 8% of the rated speed. The steady state regulation shall be adjustable within +3% to +8% of the rated speed. The dead band at rated speed and at any power output within the rated output shall not exceed 0.06% of the rated speed.

h) HP/LP Bypass

The system shall be sized to bypass 60 percent of the steam generator nominal(BMCR) evaporation corresponding to main steam flow at the turbine valves wide open, 5 percent overpressure operating condition. LP bypass shall have sufficient capacity to dump steam flow plus spray water from HP bypass. The HP and LP bypass stations capacity shall be 60% BMCR and shall be capable of meeting the following requirements:

a. Quick startup of the steam generator from cold, warm & hot conditions
b. Parallel operation of the bypass with turbine in the event of large load throw- off
c. House load operation followed by load throw-off
d. To keep the steam generator in operation so as to avoid a fire out in the steam generator following full load rejection.

i) Regenerative Feed Heating Cycle

Regenerative feed heating cycle shall consist of LP heaters, one drain cooler, deaerator and HP heaters. The number of LP & HP heaters shall be based on the optimization of feed heating cycle. Feed water shall be heated by uncontrolled turbine extraction steam from turbine inter-stage tap-offs and cold reheat line in feed water heaters, depending on optimization of cycle. The deaerator shall normally operate under variable pressure on extraction steam from the crossover pipe, between IPT and LPT modules. Each feed water heater shall be capable of handling the drains from the preceding heater under operating conditions of the unit.

Heaters shall be arranged for removal from service and bypassing of condensate flow around each heater individually excepting for HP heaters. Each train of HP heaters can be isolated & bypassed and not the individual heater.

The equipment shall be designed in accordance with latest applicable standard/code of Heat Exchanger Institute, ASME, IBR etc. The feed water heaters shall be of U-tube with all welded stainless steel tubes, surface type, and horizontal with integral condensing and drain cooling zones. The HP heaters shall also have de-superheating zone. Regenerative feed heating plant shall be designed for all operating conditions including transients like sudden load throw-off, HP-LP Bypass in operation, one or two heaters going out of service etc. The condensate from the condenser shall be pumped by the condensate extraction pumps through the train of LP heaters to the deaerator. In deaerator, the condensate shall be heated to saturation temperature and fed to the boiler feed pump, which increases the feed water pressure to suit the steam generator requirements. Feed water then passes through HP heaters, which raise the feed water temperature. Finally the feed water is fed to boiler.

j) Deaerator

Horizontal, direct contact spray or spray cum tray type deaerator with a horizontal feed water storage tank of adequate capacity shall be provided. The deaerator shall be capable of deaerating all the incoming condensate and HP heater drains. It shall effectively remove the dissolved oxygen in condensate and completely remove the traces of carbon dioxide. The deaerator shall operate without any vibration and water hammer during any transients loss of full load followed by HP-LP bypass coming into operation and at any steady load from 0% to 1 10% of rated capacity. The deaerator shall be designed to give a dissolved oxygen content not greater than 0.005 ml/litre in feed water at the deaerator outlet under all operating conditions.

k) Boiler Feed Pumps

Two nos - 2 x 50% capacity steam turbine driven feed pumps (normally working) and 1 x 35% motor driven boiler feed pump for start up with the booster pumps mounted on a common shaft shall be provided for each unit. The parameters of each BFP shall be designed to suit the steam generator requirements such that two feed pumps will be capable of meeting the full requirements of the boiler with the third pump as a standby. Turbine Driven Boiler Feed Pumps (TDBFP's) shall be located on the TG operating floor and the motor driven pump on the ground floor of TG House. These shall be accessible by turbine house EOT crane for erection and maintenance purposes. Motor driven pump shall be located on ground floor and shall be accessible to turbine house EOT crane for erection and maintenance. The feed pump shall be able to handle feed water of pH 8.5 to 9.5 and of temperature up to 290 deg C. The boiler feed pumps shall be of horizontal, centrifugal type with stiff shaft design. The boiler feed pumps outer casing shall be of barrel type with end removal arrangement. The inner pump assembly comprising of shaft, impellers, stage casings shall be capable of being removed and replaced as a unit without disturbing the feed piping. Each feed pump shall be provided with re-circulation control valve to protect the pump under low flow condition. The boiler feed water system shall be designed to operate primarily in an automatic mode over the range of system design loads. The arrangement will provide automatic start-up of the standby motor driven feed pump under conditions like tripping of running of pumps, discharge header pressure low etc.

l) Condensate Extraction Pumps

The unit shall have 3x50% capacity motor driven condensate extraction pumps (two operating and one standby). The condensate pumps shall be vertical canister type, multistage, centrifugal diffuser design with a double suction first stage designed for condensate extraction service having low suction head requirement. The pumps shall be capable of handling the condensate from the condenser together with feed heater drains when the machine is operating at maximum unit output with HP heaters out & 3% make up and discharging this quantity through the gland steam condenser and condensate polishing unit.

The pump shall have adequate margins on capacity and head to cater for most adverse conditions of operation such as:

i) HP & LP bypass in operation

ii) HP heaters out of service and unit operating at its maximum load during an under frequency operation.

m) LP Chemical Dosing System

The purpose of LP dosing system is to maintain the pH of condensate and feed water and to effectively deal with residual dissolved oxygen in condensate and feed water. The arrangement shall consist of the total system for dozing hydrazine and ammonia at boiler feed pump suction and on condensate line at CEP discharge.

n) Turbine Hall EOT Cranes

One (1) no. of electrically operated traveling cranes are envisaged in the turbine hall for erection and maintenance of turbo-generators and their auxiliaries except generator stator. The main hook capacity of each crane shall be 5% over and above the heaviest component/equipment (including lifting beam and slings etc.) to be handled in TG hall.

6.2.3 Coal Transportation / Handling System

a) Coal Transportation

Coal from mines shall be transported to the project site through bottom discharge railway wagon and shall be unloaded to track hopper. Coal from track hopper will be evacuated through paddle feeder and shall be sent to crusher for crushing purpose.

In-plant stockpile capacity has been considered for Crushed Coal stockpile for 30 days requirement. Suitable stacking and reclaiming arrangement shall be provided to transport and handle the coal from the in-plant stockpile. Space provision is identified to install wagon tipplers in future to receive coal by box – N wagons.

b) Coal Handling System

Coal received is either directly sent to the boiler bunker or to the stockpile. 2x100% capacity conveyors will be provided for the same. 2 nos Stacker-Reclaimer of required capacity will be provided for stacking and reclaiming the coal to feed the boiler bunker conveyors. Individual bunkers will be provided for each mill. Bunkers will have a storage capacity of 12 hours. From the bunker, the coal will be fed to mills by raw coal feeders.

6.2.4 Fuel Oil Handling System

Fuel oil (HFO) storage tank of capacity 2x 2000 kl and road tanker unloading facilities have been envisaged for the plant. LDO unloading and storage system is also required for the plant for initial start up of the boiler. Accordingly LDO unloading and storage system is proposed to be installed. The LDO unloading and storage system shall comprise of road tanker unloading system and 1x 1000 kl capacity storage tank.

6.2.5 Ash Handling System

The bottom ash shall be extracted in wet form and disposed off in dry form, after decanting the water. The fly ash shall be extracted in dry form from the electrostatic precipitator hoppers. This dry ash will be taken to buffer hoppers for its onward transportation in dry form to main storage silos for the use of various customers. However there may be a period during which continuous 100% ash utilization may not be possible. During such period a provision will be made to dispose fly ash from storage silos to the ash pond by providing high concentration slurry disposal (HCSD) system.

a) Bottom Ash Handling System

Ash from furnace bottom will be collected in the water-impounded hopper located below and shall be quenched. The bottom ash hopper will be furnished with seal trough, adequate number of hydro pneumatic operated gates. The hopper outlet gate will be opened to discharge and quenched and cooled bottom ash clinkers to clinker grinders. Clinker grinder will deliver the ground clinker to hydro-ejector from where the disposed bottom ash slurry will be delivered to hydro-bin or dewatering bin having storage capacity of 12 hours collection.

In hydro-bin the slurry will be dewatered with bar screen, decanting unit, serrated weir and other accessories mounted in it. In this process of segregation of ash from water, ash water will be pumped to hydro-bin over a bar screen, which will permit the finer material to drop vertically into center. The coarser particles will be diverted towards the sides of bin. Top water or excess water will be siphoned off by means of overflow troughs, floating decanting elements until the ash pile is stuck. The overflow will be drained in settling tank below where carry over dust will be allowed to settle. A sludge pump will be used to purge or clean the settle material back to hydro-bin. Clear water then will overflow through gravity into a clear water storage tank for recycling located nearby. HP/LP water pumps will supply this clarified water to hydro-ejector, flushing nozzles.

Nearly dry bottom ash will be discharged through the bottom of hydro-bin by means of a hydraulically operated gate. Overflow tank located in bottom ash hopper area will collect excess ash water in bottom ash hopper continuously through overflow seal box and troughs and will be pumped to hydro-bin by overflow pump.

b) Fly Ash Handling System

Pneumatic conveying system (either vacuum system of pressurized system) shall be employed for extraction of fly ash from the electrostatic precipitator hoppers in dry form. This dry ash shall either be taken to buffer hoppers or to the wetting head/collector tank units. The dry ash buffer hoppers and wetting head/collector tank units shall be located adjacent to the ESP. Dry ash from buffer hoppers shall be transported to main storage silos to be located near the plant boundary. Main Silo area shall be provided with fencing, office block, gate complex and passage for entry/exit of vehicles. The user industries shall take the dry fly ash from these silos (having storage capacity of 24 hours ash collection) either in closed tankers or in open tankers. For wet disposal of dry ash extracted from various ESP hoppers, the same shall be diverted to wetting head/collector tank units/ bypassing buffer hoppers meant for handling ash in dry form.

Fly ash collected in air pre-heater hoppers, economizer hoppers, and stack hopper (if provided) shall be extracted and disposed in dry form similar to ESP hopper fly ash.

c) Fly Ash Slurry Disposal System

The fly ash (in case of emergency) in slurry form shall be led to the common slurry sump of the combined ash slurry disposal pump house. 6x100% streams (one stream for each unit with two common standby streams) of pumping and piping will be provided. The disposal ash pond area is located outside the plant boundary. There shall be a common ash slurry pump house. All the pumping streams shall be provided with its individual disposal pipes.

d) Ash Water System

Initially water for ash handling system shall be made available from cooling tower blow down.

6.2.6 Water System and Plant Utilities

a) Source of Water

The source of raw water for the project is sea water from Bay of Bengal which is about 2 kms away from the project site. The water would be pumped with the help of a pump house.

b) Water Requirement

Sea water make up requirement for this project of 4x660 MW would be about 29166 Cu. M/hr 6,80,000 cu.m/day

c) Type of Circulating Water System

Present environmental regulations stipulate that the power projects, to be commissioned after 01.06.99, shall install cooling tower. Therefore, re-circulating type CW system with cooling towers has been envisaged for the project.

d) Service and Potable Water System

A pipe network for distribution of potable water for plant shall be provided from the overhead storage tanks. In addition potable water requirement for the colony shall be supplied from the water treatment plant. Required number of potable water pumps for colony and plant area shall be provided.

A service water pipe network spread over the entire plant area would be provided for cleaning of main plant area and other buildings. Required number of service water pumps shall be provided which shall draw water from the service water tank.

In addition to the above, DM water make up water system, boiler fill pumping system, Air preheater wash water system and HVAC make up system shall also be provided as per requirement and required quantity of pumps for these services and their parameters shall be finalized as per final plant layout and requirements of the main plant equipment.

e) Water Demineralization Plant

DM plant is envisaged to ensure make-up requirement of heat cycle at the rate of 1.5 % of the BMCR steam flow, make up to closed circuit auxiliary system, hydrogen generation plant (if applicable) and stator water-cooling system. Configuration of the DM Plant will be such that at least one stand by stream is available. DM water will be stored in two nos DM water storage tanks. DM water storage tank capacity is adequate to meet 20 hrs make-up requirement for all the two Units. The three nos. (3x50%) DM water Transfer pumps will be provided to transfer the DM Water from the DM plant storage tank to Condensate storage tanks for further heat cycle make up system.

The DM Water cycle make-up system will consist of 3x50% cycle make up pumps for feeding to condensate hot well as well as feed water storage tank. Besides, there will be 2 x 100% SG fill pumps for direct filling of SG with Demineralized Water.

These pumps will be located near Condensate storage tank.

f) Effluent Treatment Plant

The liquid effluents shall be collected and treated/recycled generally as per the following.

The filter backwash water of PT plant shall be collected and recycled back to the DM system clarifier.

The sludge from clarifiers of Water PT Plant shall be collected in a sump/ pit and shall be pumped to ash slurry sump for disposal to ash dyke.

The waste effluents from neutralization pits of CW chemical treatment system, condensate-polishing plant, DM plant shall be collected in the respective neutralization pits and neutralized before pumping to the central monitoring basin before final disposal.

The oily waste from main plant area shall be treated using oil water separator and the treated water shall be led to the tube settler provided for service water waste for further treatment. Similarly separate system shall be provided for oily water in fuel oil unloading and storage area.

Back wash water from CW system side stream filters and service water effluent drains from various areas shall be separately routed to a sump. From the sump the service water shall be pumped up to plate separators/tube settler for treatment of suspended solids. Treated service water shall be sent back to service water tank for reuse.

All the plant liquid effluents shall be mixed in central monitoring basin (CMB) and finally disposed off from CMB up to the final disposal point through carbon steel pipe using adequate capacity pumps. Oil separator will be provided to trap oils from effluents arising from oil handling area.

The waste from coal handling plant would be high in suspended solids. A settling chamber would be provided and wastewater from coal stockyard, transfer points etc. would be routed to the chamber. The decanted waste from the settling chamber would be used for coal stockpile dust suppression system.

6.2.7 Fire Detection and Protection System

A comprehensive fire detection and protection system is envisaged for the complete power station. This system shall generally conform to the recommendations of TAC guidelines & NFPA - 850.

The following fire detection and protection systems are envisaged.

1. Hydrant system for complete power plant covering the entire power station including all the auxiliaries and buildings in the plant area. The system shall be complete with piping, hydrants, valves, instrumentation, hoses, nozzles, hose boxes/stations etc.
2. Automatic high velocity water spray system for all oil filled transformers located in transformer yard and those of rating 10 MVA and above located within the boundary limits of plant, main and unit turbine oil tanks and purifier, lube oil piping (zoned) in turbine area, generator seal oil system, lube oil system for turbine driven boiler feed pumps, consisting of detectors, deluge valves, projectors, valves, piping, instrumentation etc. all oil filled transformer protected by HVWS.
3. Automatic medium velocity water spray system for cable vaults and cable galleries of main plant, switchyard control room, CHP control room and ESP control room consisting of smoke detectors, linear heat sensing cable detectors, deluge valves, isolation valves, piping, instrumentation, etc.
4. Automatic medium velocity water spray system for conveyors, galleries, transfer points and crusher house consisting of QQQB detectors, linear heat sensing cables, deluge valves, nozzles, piping, instrumentation, etc.
5. Automatic medium velocity water spray system for un-insulated fuel oil tanks storing fuel oil having flash point 65 deg C and below consisting of QB detectors, deluge valves, nozzles, piping, instrumentation, etc.
6. Foam injection system for fuel oil/storage tanks consisting of foam concentrate tanks, foam pumps, in-line inductors, valves, piping & instrumentation etc.
7. For protection of control room, equipment room, computer room and other electrical and electronic equipment rooms, suitable "Halon substitutes" such as "INERGEN" of "AGRONITE" system would be opted.
8. Fire detection and Alarm system - A computerized analogue, addressable type early warning system shall be provided to cover the complete power plant. Following types of fire detection shall be employed.
   a. Ionisation type smoke detection system
   b. Photoelectric type smoke detection system
   c. Combination of both ionization type and photoelectric type smoke detection systems
   d. Linear heat sensing cable detector
   e. Quartzoid bulb heat detection system
   f. Infra red type heat detectors
   g. Spot type heat detectors

9. Portable and mobile extinguishers, such as pressurized water type, carbon-dioxide type, foam type, dry chemical powder type, will be located at strategic locations throughout the plant.
10. Required fire tenders/engines of water type, DCP type/foam type, trailer pump with fire jeep etc shall be provided in the fire station.
11. CW system blow down shall be used for supply of firewater. It is proposed to provide two numbers of mild steel water storage tanks, which shall be fed from the CW, blow down water. An over ground fire water pump house shall be constructed near these firewater storage tanks. Horizontal firewater pumps shall be installed in the pump house for hydrant and spray system and the same shall be driven by electric motor and diesel engines as per the TAC guidelines. The water for foam system shall be tapped off from the hydrant system pumps.
12. For the above firewater pumping station, automatic pressurization system consisting of jockey pumps and air compressors shall be provided.
13. Complete instrumentation and control system for the entire fire detection and protection system shall be provided for safe operation of the complete system.

6.2.8 Plant & Instrument Air System

For instrument air requirement of main plant and auxiliaries eight (8) numbers of air compressors with required Air Drying Plants (ADP) of same capacity are envisaged for 4 x 660 MW units. The discharge pressure of the compressors shall be such that a delivery pressure of 7.5 kg/cm2 (g) is available at the outlet of ADP. The compressors shall be of oil free screw type and shall provide moisture and oil free air. These compressors shall be provided with all the accessories such as suction filters, inter coolers, after coolers, air receivers etc.

The air-drying plants will be desiccant type and shall be capable of achieving a dew point of (-) 40 deg. C at atmospheric pressure. Individual air receiver shall be provided near each air compressor and further unit air receivers shall be provided near main plant of each unit.

Two (2) numbers of plant air compressors of adequate capacity shall be provided to meet the service air requirements of 2 x 660 MW Units. The compressors shall be of same type as that of the instrument air compressors.

6.2.9 Air Conditioning System

Air conditioning system shall be provided for all those areas, which require close control of environment conditions and shall cover the following areas:

1. Central Control Room consisting of Control Rooms, Control Equipment rooms, Telecomm-unication Rooms, Microprocessor, Computer and Programmers Rooms, Data Storage Rooms, UPS Rooms, Instrumentation Laboratory and Steam & Water Analysis Rooms, Conference Room, Shift Charge Engineer's Room (if applicable), Relay Rooms.
2. ESP Control Room
3. Coal Handling Plant Control Room
4. Switchyard Control Room including Computer Rooms, Telemetry Room, PLCC & Telex room

5. Required areas in Service / Facilities Building / Administration Building
6. Water Treatment Plant Control Rooms, Water and Fuel Analysis Room, Instruments Room.
7. Any other area, which contains control and instrumentation equipment requiring air conditioning or otherwise requires to be air conditioned.

A central water cooled chilled water type air conditioning plant shall be provided for air conditioning of central Control Room and its associated area. Chilled water from the central plant shall be pumped to various air-handling units catering each area or groups of area of central control room.

A central water-cooled D-X type air conditioning unit with required number of air handling unit shall be provided for ESP control room area. .

A central water-cooled D-X type air conditioning unit with required number of air handling unit shall be provided for coal handling pant control room area.

A central water-cooled D-X type air conditioning unit with required number of air handling unit shall be provided for switchyard control room.

A water-cooled central chilled water type air conditioning plant shall be provided for air conditioning of Service/Facilities Building/Administration Building area. Chilled water from the central plant shall be pumped to various air-handling units/ fan coil units (as appropriate) catering each area or groups of area of service / facilities building/administration building.

For other misc. area, either package type air-conditioning unit or D-X type air conditioning unit shall be provided as per requirement.

In determining air conditioning load (TR), equipment load, heat load due to solar heat gain, occupancy, lighting and transmission gain shall be considered as per established design practice.

All air conditioned space which are normally manned shall be maintained at 24.4 deg C ± 1 deg C, 50% ± 5% Relative Humidity (RH) and the other areas such as control equipment rooms etc. which are not normally manned shall be maintained at 22 deg C ± 1 deg C, 50% ± 5% RH.

Further critical areas like programmer's room, control room etc, which are required to be air conditioned even during failure of normal power supply shall be provided with emergency package air conditioners which shall operate on emergency Diesel Generator sets.

All air-conditioned areas shall be supplied with filtered air. Both re-circulated and fresh air shall be filtered separately.

All air conditioning equipment shall have adequate redundancy and as minimum following redundancy shall be provided: -

a) All condensing/chilling units : 100% standby
b) All pumps (Chilled & Condensate water : 50% standby
c) All air handling units : one unit standby for each area
d) Cooling towers : 100% standby

6.2.10 Ventilation system

Ventilation system shall be designed to supply fresh outdoor air and shall be selected for maintaining inside conditions for those areas where close control of temperature is not required, but nevertheless have a stipulated maximum temperature.

The areas to be ventilated shall be as follows:-

1. All floors of turbine hall including "BC Bay" other than the area, which is air-conditioned.
2. Switchgear rooms and cable galleries of main plant
3. Non air conditioned area of ESP control room
4. Any other areas where equipment heat load is high and requires ventilation by evaporating process

All other buildings/areas such as switchgear rooms, pump houses, store, canteen and toilets etc. shall be ventilated by mechanical ventilation process using combination of supply air fans and roof exhausters or wall mounted exhaust fans.

All evaporating cooling system shall be designed based on 90% saturation efficiency of air washer. Air quantity shall be selected in such a way so as to maintain an inside temperature of 2 deg C below maximum design ambient (DBT) during summer or a minimum air change rate of 5 to 6 per hour which ever is higher.

All mechanically ventilated areas shall be designed to a maximum inside temperature of 3 deg C above maximum design ambient during summer or 10 air change rate per hour (for general area) and 15 air changes rate per hour for battery room whichever is higher.

All ventilation system shall work on 100% fresh filtered air.

Turbine hall and electrical switchgear/control rooms shall be designed for positive pressure ventilation, which shall be achieved with the assistance of roof extractors besides air washer by sizing the exhausters to extract 75% of total air delivered by supply air fans. All battery rooms, kitchens, toilets shall be designed for negative pressure ventilation.

6.2.1 1 Hydrogen Generation Plant & Bulk Gas Storage

A hydrogen generation plant has been envisaged in order to fill up high-pressure hydrogen cylinders, which are required for generator initial fill up and regular make up required for generator rotor cooling. Hydrogen generation is accomplished by water electrolysis process. It is proposed to provide a hydrogen generation plant of suitable capacity for the project with electrolysers, hydrogen and other auxiliaries. The plant shall be designed as per the regulations of the Explosives authority with all the required safety aspects, instrumentation control, including on-line hydrogen purity analyzer system and control panel.

6.3 Electrical Equipment and System Design

6.3.1 Plant Design Concept

The steam turbine of each unit shall be directly coupled to 660 MW synchronous generators for generation of power. The generating voltage would be around 22 KV which will be decided by manufacturer's standard. The generating voltage is considered for stepping up to 400 kV level by Generator Step Up Transformer.

The steam turbine of each unit shall be directly coupled to 660 MW synchronous generators for generation of power. The generating voltage would be around 22 KV which will be decided by manufacturer's standard. The generating voltage is considered for stepping up to 400 kV level by Generator Step Up Transformer.

The Electrical System is proposed as per the Generation Scheme and the same is considered for the design of the Plant Electrical System and 400 kV Switchyard Layout.

A 400 KV switch yard adjacent to the power plant will be constructed for receiving the generated power from the power station at 400 KV. The electrical system requirement and major equipment for generation, station service auxiliary power supply, power evacuation by 400 KV transmission lines are exhibited in the Electrical Single Line Diagram (Annexure – 5).

6.3.2 Electrical System Arrangement

As per standard practice the generators will be connected to the Generator Transformers by isolated phase bus ducts and the generator transformer to the 400 KV switchyard by overhead conductors.

The 400 KV switchyard is considered out door air insulated type equipped with circuit breakers, isolators, current transformers, capacitive voltage transformers wave traps. lightning arresters, ground mat, shield wire as per standard practice. Incase 765 KV power evacuation is stipulated by the grid authority, the same would be envisaged in place of 400 KV system.

The power supply requirement for the power plant will be for the requirement of each unit which is unit auxiliary power and for the station loads such as coal handling, water system, ash handing, illumination, ventilation, Air conditioning etc. For start up of the unit power will be taken from the grid by the station transformers and after the generator is synchronized with the grid the unit auxiliary power will be supplied by the unit auxiliary transformers. Thus for each unit, there would be two unit auxiliary transformer of 50 % capacity connected to the generator isolated phase bus duct. The down stream voltage in the power station would be 11 KV for meeting the requirement of boiler feed pumps and 3.3 KV for other medium voltage motors like mills, fans circulating water pumps, compressors, etc in order to meet the load of low voltage motors, 415 volt level will be required which will be fed from 1 1 /0.433 kilo voltage auxiliary transformers. Thus in the power station the following voltage level would be introduced for the electrical system as shown in Table-6.3.

Table – 6.2

Different Voltage Level

S.No	Description	Voltage level
1.	Generating Voltage	Voltage level
2.	Switchyard voltage	22 KV or as per manufacturer standard
3.	Medium voltage in power plant	11 KV and 3.3 KV
4.	Low voltage load	415 V

The Transformers i.e., generator transformers, unit auxiliary transformers, station transformers and 11/3.45 kV transformers shall be installed in the transformers yard between the power station and the 400 kV switch yard. The LT service transformers are generally dry indoor type. The electrical system is represented in the Electrical SLD (annexure 5) up to 11 KV level. The system described above will cover in general by the following system and equipment:

- 400 KV switch yard with associated equipment – 2 nos GT feeder, 4 nos 400 kV Transmission Line feeders, 2 nos ST feeder
- 7 nos. 22/420/ √3 KV , 270 MVA single phase generator transformers (with 1 spare)
- 2 nos generator bus ducts of 22 kv
- 4 nos. 35 MVA 22/11.5 KV unit transformers
- 2 nos 80 MVA 400/11.5/11.5 KV station transformers
- 4 nos., 16 MVA 11/3.45 KV unit auxiliary transformers
- 11/3.45 KV transformers for BOP
- 11 KV & 3.3 KV Unit and station switch gears with bus ducts and 415 V switch gears with associated bus ducts
- 415 V MCC/PMCC/DBs
- 220V & 48 V battery chargers, DCDB and batteries
- Electrical control and protection panels
- 415 V 1500 KVA DG sets
- Neutral grounding transformers, resistors etc
- Ground mat and lighting protection system
- Auxiliary equipment like cables,UPS, illumination communication, laboratory equipment, construction power etc.,

The capacity and rating of the equipment mentioned above are indicative only for a power plant of this capacity.

6.3.3 Generators

The 660 MW synchronous turbo generators will be coupled directly to the turbine. The technical parameters of the generators will be decided by the manufacturer's standard design. The indicative major technical parameters of the generators are given in

Table 6-3

S.No	Description	Unit	Parameters
1.0	Maximum continuous rating	MW	660
2.0	Generating Voltage	KV	22
3.0	Power factor		0.85 lagging
4.0	RPM	Rotation / Minute	3000
5.0	Type of cooling		Hydrogen / Water cooling
6.0	Insulation Class		Class F but temperature rise limit to class B
7.0	No of phases	No.	3

The generator will be connected to the 400 KV generator step up transformer by bus duct and then to the 400 KV switchyard from the step up generator transformer by overhead conductors. The generators will be synchronized from the unit control room by the 400 KV generator circuit breaker. The protection, control, monitoring and synchronization system for the generator will be provided in the unit control board.

6.3.4 400 kV Switchyard:

It is proposed to connect the power plant with the nearest 400 KV substation of STU/CTU for power evacuation of generated power. Such interconnection facility would come in a big way for time to come in interchanging power with the National Grid with lesser transmission loss and with more reliability. Start up power for the power plant could be drawn from the 400 kV switchyard which in turn is connected to the Western Regional Power Grid.

In the 400 KV switchyard, standard one and a half breaker configuration is considered. Encapsulated single phase SF6 circuit breakers for 400 KV switchyard are considered.

Plant shall comprise Four (4) Nos. Generator Transformers with Eight (8) 400 kV lines evacuating the generated power and also feeding the Four (4) Station Transformers. The scheme is shown in the Electrical SLD.

6.3.5 Transformers

In consideration of the size and weight of three phase generator transformers for the 660 MW units it would provide better mobility at site and ease in handling in transport if three numbers of single phase transformers to make a three phase bank is considered. For the three units one single phase unit could be provided as spare. Therefore seven (7) number of single phase 22 / 420/.,/3kV Transformers would be a better choice. It would require more space in comparison to three phase banks but would be cost effective considering availability of the transformer as the spare single phase unit could replace at minimum time any one single phase unit in service in the event of failure.

Four (4) numbers of 22/11.5 KV Unit Transformer (UT) for unit service and two(2) numbers of 400/11.5/11.5 kV Station Transformers (ST) for station service have been considered. In addition, 11/3.45KV auxiliary transformers and11 /0.433KV service transformers will be required for meeting the auxiliary loads. All the transformers except the LT service transformers would be of standard design. Dry type transformers could be considered for the LT transformers.

6.3.6 Power Evacuation

For this project, the power from 4X660MW generator shall be evacuated from the eight (8) numbers of 400kV Transmission lines.

The numbers of transmission lines considered would be adequate for evacuation of power from the power plant in the event of one (1) 400 KV line outage . The 400 KV transmission lines shall be constructed with twin Moose ACSR conductor as per standard practice. Power System studies in consultation with STU and CTU shall however need to be carried out for absorption of the power by the grid under system transient conditions with the proposed transmission lines.

6.3.7 Generator Bus ducts

a) Isolated Phase Bus Duct

Two sets of Isolated Phase Bus (IPB) ducts conforming to generating voltage shall be required for connection of generator phase terminals with the generator transformer. Tap off connections shall be provided from the IPB for connection to the Unit Transformers (UT) and Surge Protection and Voltage Transformers (SP&VT) cubicles of the generator. Current Transformers for the generator and the UT's shall be installed in the run off of the IPB from the Generator to the Generator Transformer.

b) 11kV, 3.3 kV and 415 V bus duct

For providing connection facility between the low voltage side of UTs, STs and service transformers and their respective switchgear, isolated phase bus duct/segregated phase bus duct of 11 KV, 3.3 KV and 415 V are considered. Further the tie connections between the 11 kV station and unit switchgear and 3.3KV switchgears also will be provided by bus ducts.

c) 11kV, 3.3 kV and 41 5V switchgear

For each unit, 11kV indoor metal clad, unit switchgear shall be provided which will receive power from the UTs and for the station service 11kv station switchgear will be provided for receiving power from STs. The 11 kV unit switchgear and the station switchgear shall be suitably interconnected by tie bus ducts. The large unit loads and station loads shall be fed from these 11 kV switchgear. Load for Coal handling system, intake power house also will be met from the 11 KV switchgear. However, for any external loads if required to be met from the station 1 1 KV system, cable connection is preferred with suitable protective system so that external fault does not affect the station power supply system. 3.3kV Switchgear will receive power from 11 kV switchgear through 11/3.45kV transformers for meeting units service loads of motors of lower ratings.415V switchgear will receive power from 11 kV or 3.3kV switchgear through 11/0.433KV or 3.3 /0.433KV service transformers. All LT loads will be met from the 415 switchgear / MCCs / DBs.

d) Emergency Power

In order to meet emergency power in the event of total power failure one DG set of adequate capacity for each unit is considered. The emergency DG set will provide safe power supply for shut down of the units and for other essential loads as emergency lights, battery chargers, UPS loads, communication, etc.

e) 220 V, 48 V DC systems

For control and protection of the various control system of the generators, transformers, motors, etc. 220 V DC system is envisaged. The system will include DC distribution boards (DCDB) powered from battery chargers and back up batteries of adequate capacities. One set of 220 V DC system is preferred for each generator and the 400 kV system. For power line carrier communication (PLCC) 48 V DC system with batteries and battery chargers shall be provided.

f) Uninterrupted Power Supply (UPS)

In order to meet controlled 240 V AC power supply in the control and monitoring system, signaling and distributed control system (DCS) stable 240 V AC power supply will be met from UPS comprising of stabilizers, batteries etc. One common UPS system shall be provided for the Power Station.

g) Control and Protection

The control and protection panels for the generators and generator transformers shall be provided in Unit Control Panel (UCP) located in the Unit Control room from where all controls of the generator shall be done. For the control of the , transmission lines, bus bars, etc. control and protection panels with SCADA system is envisaged which will be provided from the switchyard control room. In addition, for the entire plant a Distributed Control System (DCS) is envisaged which will be provided in the Unit control panel. All important controls including 11 and 3.3 kV, 41 5 V switchgear shall be done from the DCS.

For control and protection system there would be redundant system for back up.

h) Construction Power

It is envisaged that construction power at 33 kV shall be provided at the power plant from the local distribution company at a distance of about 8km. Power will be received in one 33 kV outdoor substation from where feeder shall be provided to the construction agencies.

i) Start Up Power

Start up power for the units could be received from the 400 kV switchyard of the power plant to which the station transformers are connected as shown in the Electrical SLD.

6.4 Control and Instrumentation

6.4.1 Design Philosophy

Distributed Digital Control, Monitoring and Information System (DDCMIS) based Control and Instrumentation system has been envisaged for the plant comprising of Two (2) Units each of 1 Steam Generator (SG) and 1 Steam Turbo Generator STG. The main plant equipment including SGs, STGs and associated main plant auxiliaries shall be controlled and monitored from CRT based operator interface units in Central Control Room. Plant Offsite control system shall be interfaced with DDCMIS for Limited Control, Monitoring from Central Control Room Control and monitoring of the plant shall be performed through CRT based operator stations through different displays which shall include mimic displays, control displays, bar-graphs displays, alarms, operator guide messages, logs, summaries and reports. Operator Station shall be designed for safe, efficient, reliable and convenient control, operation and monitoring of the unit. Operator Interface Unit will consist of Operator Terminals (OT) with CRT/KBD/Mouse, printers, hard copiers, Large Video Screen (LVS) etc.

6.4.2 Distributed Control System. (DCS)

Distributed Digital Control, Monitoring and Information System (DDCMIS) consists of Control and measurement systems including modulating controls, interlock and protection systems, sequential controls and drive controls; Man- Machine Interface (MMI); Data Communication; Management Information System; Historical Storage and Retrieval System; Sequence of Events Recording System;

Plant Performance Calculation Package; System programming and Documentation Facility; Field Instrumentation etc.

The following major control and monitoring sub-systems shall be envisaged in DDCMIS. These are grouped on the basis of main plant equipment and auxiliaries and their functional distribution.

- SG with associated auxiliaries
- STG with associated auxiliaries
- Offsite system & equipment
- Electrical System

These sub-systems shall be properly configured and grouped to provide optimized configuration with required level of redundancy.

DCS will be of Open Architecture type having high system availability and reliability. The general configuration of DCS is indicated in Annexure 6. The configuration diagram enclosed is only generic in nature and tentative.

Plant abnormal conditions shall be alarmed through CRTs of the Operator Stations and Large Video Screen (LVS) for each Unit. Alarm printer shall be provided to print out all alarms with time tagging and in the chronological order. Sequence of Event Recording (SER) system with 1 millisecond resolution shall be provided to record and print trip and causes of trip for quick diagnostic of fault and remedial action.

Modular system design shall be adopted for DDCMIS to facilitate easy system expansion including online self-surveillance, monitoring and diagnostic facility. DDCMIS shall be fault tolerant to provide safe operation under all plant disturbances and component failure. On line diagnostic features shall be provided as a part of DDCMIS which shall include monitoring and communication of system faults, individual subsystem faults including fault identification down to individual channel of electronic modules.

DDCMIS shall be provided with redundancy for group controllers, critical subgroup controllers, all CLCS controllers, and field instrumentation as required, power supplies, communication highways, all communication controllers etc. The control of redundant plant equipment shall be achieved through separate electronic hardware and software associated with each functional group. The data high way shall be configured in hot redundant mode.

6.4.3 Steam Generator Control System

The SG control system shall include Furnace Safeguard and Supervisory System (FSSS), Secondary Air Damper Control (SADC), Auxiliary PRDS Control System. (APRDS), Mill & Gravimetric Feeder Control System, Steam Generator Auxiliaries Controls, Soot blower Control System, HFO & LFO Controls, Chemical Dosing Control, Electromatic Relief Valve Control, Steam, Water, Air and Flue Gas circuit process parameter controls and other miscellaneous control. Each SG shall be provided with protection system for tripping of the SG in an emergency condition. The protection system shall be implemented in triple redundant system with necessary redundancies in controllers, power supply and other cards. The FSSS and protection system for tripping of the SG can also be provided as a proprietary

control system and shall be interfaced with DDCMIS for unified control of the Plant from Central Control Room.

6.4.4 Steam Turbine Generator Control System

Each STG shall be provided with automatic sequential control system for run up, synchronization, loading, unloading and shut down operation. The system shall include auto operation of various auxiliaries / sub systems like control oil sub system, lube oil sub system, Steam Turbine lift and barring sequence, vacuum raising, steam drain operations etc.

The governing system shall be provided with redundant configuration for each ST which shall include speed and load controllers, frequency droop controllers, steam pressure controllers with due consideration of turbine stress.

Other steam turbine instrumentation / systems such as Turbo Supervisory Instrumentation, Turbine Stress Evaluator, Automatic Turbine Testing System, HP & LP Bypass Control System, Generator Auxiliaries Control System & H2 Generator system, Automatic Voltage Regulated System, One set of conventional synchronization facility for the synchronization of generators associated Field Instrumentation etc. shall also be provided for each STG Module.

Each STG shall be provided with protection system for tripping of the turbine in an emergency condition. The protection system shall be implemented in triple redundant system with necessary redundancies in controllers, power supply and other cards. The Turbine control and protection system for tripping of the STG can also be provided as a proprietary control system and shall be interfaced with DCCMIS for unified control of the Plant from Central Control Room.

6.4.5 Off Site control system

The plant Offsite systems like Pre-treatment and Demineralising plants, Ash Handling system, Coal Handling System, Air compressor system, fire fighting system, air conditioning and ventilation system etc. shall be controlled and monitored through dedicated control and monitoring systems. Color graphic CRT/KBD/mouse shall be used as the operator interface device for these offsite systems where PLCs shall be used. These shall be kept in the local control rooms. Major equipment of Offsite systems shall be controlled and monitored in DDCMIS for central monitoring and alarm purpose.

6.4.6 Electrical Control Systems

Operation and Monitoring of Plant Electrical and downstream System will be performed through DDCMIS. The Electrical system functional groups shall be used to monitor the status of electrical systems through DDCMIS. The switchyard control system, located in switchyard control room shall be provided with standard data link / hardwired connection with the DDCMIS for monitoring purpose.

6.4.7 Steam Water Analysis System:

A comprehensive Steam and Water Analysis System (SWAS) shall be provided for continuous on line monitoring of water and steam purity in the plant cycle. Conductivity, pH, Hydrazine, Dissolved Oxygen, Silica, Sodium, Phosphate and Chlorine analysers shall be provided. SWAS will consist of Sample Conditioning Panel (Wet Panel) and Analysers Panel (Dry Panel) located in air-conditioned SWAS room. Primary sample conditionings are to be implemented in the field.

6.4.8 UPS System

An uninterrupted power supply (UPS) system in 100% hot redundant configuration will be provided to cater to single phase, 230 1 120 V AC 50 Hz, 2 wire power supply requirements of instrumentation and control systems viz. DDCMIS Cabinets, man-machine interface equipment, analysers, instruments mounted on the unit control panel and other independent systems. Other voltages required shall be derived from the UPS source. The UPS system shall be housed in a separate room suitably located in the Main Plant Building A redundant UPS system shall comprise of 2x100% redundant inverters, 2x100% redundant chargers, one set of batteries, static switches, bypass transformer and static voltage stabilizer, manual bypass switches and AC distribution board.

AC distribution board will be provided as per requirement to Supply AC power to different loads. DC supply and distribution system required for DCS shall be derived from UPS System. Redundancy in power supply units of different voltage levels shall be provided for all types of critical control panels.

6.4.9 Master & Slave Clock

A Master and Slave Clock System shall be provided for the complete plant in order to maintain uniform timing throughout for the various plant facilities and also for time synchronization between various systems including DDCMIS, Main Plant Equipment Control Systems, SCADA, SER etc. of all Modules. The system shall include two master clocks in 100% redundant configuration (one working and the other stand by) and slave clock display units. Facility to control these master clocks through Global Positioning System (GPS) shall be envisaged.

6.4.10 Emission Monitoring System

Emission monitoring systems shall be provided as a complete unit for each Module. This shall comprise of Opacity / Suspended Particulate matter monitoring system, S02 and NOx monitoring system, CO monitoring and Flue Gas Oxygen monitoring system etc. All these system shall be highly reliable, accurate and shall have long term stability in span, zero and calibration accuracy.

6.4.1 1 Vibration monitoring system for major plant auxiliaries

The Vibration Monitoring System will be provided for all critical equipments including ID Fans, FD Fans, PA Fans, CEP, Boiler Feed Pumps, CW Pumps etc for condition monitoring and analysis of critical Mechanical equipment. The System will be complete with Proximity Type Vibration Sensors, Amplifiers, Special Cables and monitors with all necessary equipment and accessories. The system shall be interfaced with the DDCMIS system.

6.4.12 Smart Transmitter Maintenance Station

Dedicated standalone PC based Smart Transmitter Maintenance Station (STMS) will be provided for centralized configuration, maintenance diagnostic and record keeping of all electronic smart transmitters. Transmitter signals will be wired parallel to DDCMIS control system and HART modules of STMS, which will be connected to PC through suitable communication modules. Complete diagnostic, record keeping, calibration and configuration, event and log reports, historical database records of all transmitters will be possible from the STMS.

6.4.13 Field Instruments

All field transmitters are envisaged to be smart type having 4-20 mA DC signal output with 100:1 turndown ration and with superimposed digital signal conforming to HART or any other internationally accepted protocol. Four(4) nos. portable digital calibrator/HART communicator are envisaged for on line calibration of the transmitters. Accuracy of process transmitters is envisaged as 0.1 %. Accuracy of local gauges (PG, TG etc) is envisaged as 1% all temperature elements (RTD/Thermocouple) will be duplex type. Thermocouple will be mineral insulated type. Measurement of steam flow, feed water flow condensate flow, SH & RH attemperation flow and BFP recirculation flow is proposed with the help of flow nozzles. In light oil & heavy oil flow service Coriolis type mass flow meters have been envisaged. Orifice plates will be used in other water services.

All level switches would be external chamber float operated type. All level switches and level transmitters for vacuum service will be displacer type.

Field instruments would be suitably grouped and clustered area wise and would be terminated in local junction boxes for onward connection to the DDCMIS marshalling cabinets.

6.4.14 Final Control Elements

In general, control valves, dampers and other final control elements would be of pneumatically operated type except for HP/ LP bypass and other critical valves, which will be of hydraulic operated type and Fan/Pump flow/speed control devices which will be operated by electric / hydraulic actuating mechanisms. Control valves will have wide range of controllability, less noise and have adequate fail-safe feature.

Electric to pneumatic converters will be provided for pneumatically operated final control elements to interface with the DDCMIS. Each final control element will be provided with pneumatic positioners, smart type electronic position transmitter of 4-20 mA output, air lock relay, air filter regulator, hand

wheel, limit switches, solenoid valves and other accessories in accordance with the system requirements. In case of control signal or pneumatic supply failure, the final control element should go to fail safe position.

For special applications such as hazardous areas, actuators/electric-pneumatic converters will be selected based on specific application requirements.

6.4.15 Instrumentation & special cables

Individual / pair shielded and overall shielded twisted pair color coded copper cables would be used for analogue signals and overall shielded cables would be used for digital signals. All these cables are armored. All the insulation including overall sheath would be FRLS quality. The size of the wire would be 0.5 Sq.mm. FRLS 2.5sq.mm copper control cable would be used for cabling for services like field solenoid valve to the control system. Compensating cables will be provided for connecting the thermocouple inputs to the measurement system of DDCMIS and up to temperature transmitters for closed loop control system. The interconnecting cables between any two cabinets and between cabinets and panels would be of prefabricated type. The communication bus of the DDCMIS would be coaxial / twisted pair cable.

6.4.16 Maintenance and Calibration Instruments

One set of Maintenance and Calibration Equipment for instrumentation and control systems, common for both Units of the plant will be provided. This would consist of calibration equipment such as electronic test bench, pneumatic test benches, dead weight tester, manometers, air sets, RCL Bridge, digital channel simulator, logic probe, testing meters / devices / calibrators for at site testing and calibration, etc.

6.5 Erection Hardware

All required installation hardware including impulse pipes, tubes, valves, manifolds, pneumatic piping, fittings, air filter regulators, supporting hardware and other special accessories as required for proper installation and interconnection of instrumentation and control systems shall be provided. Instrument process tubing and air tubing to be designed shall be in accordance with the process parameters.

6.6 Emission monitoring system

Portable analyzer shall be employed for the emission monitoring in the flue gas from stacks. Emission monitoring system shall comprise of SPM, SOX and NOX monitoring system, CO monitoring system Emission Monitoring system etc. This portable analyzer shall be highly reliable, accurate and shall have long term stability in calibration accuracy. The system shall have communication facility with Plant DCS. Continuous ambient monitoring system shall also be provided for the plant for monitoring of ambient air parameters like temperature, relative humidity, wind velocity, rain fall etc. and percentage of pollutants (SPM, SOX, NOX and CO) in high volume sample of air once in a day.

6.7 Civil Works

6.7.1 Land Development

The formation level will be decided taking into consideration the natural ground contour, system requirements, high flood levels and requirement of minimum earthwork for site leveling. The site grading level will have to be fixed with due consideration to site drainage. The finished ground level will be maintained above high flood level (HFL) of the area. Reasonably graded land area is available for the installation of the proposed plant.

6.7.2 Foundation Design Philosophy

The foundations will be designed using reinforced concrete of appropriate grade so as to resist the loading imposed by the building, structure or equipment to be supported.

The foundation design criteria will be established based on actual geo-technical investigation report to be carried out at present site location. Foundation system to be adopted must ensure that settlement/ relative settlement shall be as per provision of relevant standards.

Foundation system of SG / Fans / Mills and Steam Turbine Generator, Boiler Feed Pumps, etc. will be decided as per manufacturer's recommendation during detail engineering stage.

All foundations will be designed in accordance with the provision of the latest revision of IS standards. The provision of DIN/other International Standards shall also be followed for machine foundations. Foundation system may be open foundation or pile foundation as per recommendation in the Geotechnical Investigation Report .

For concreting work grade, type of aggregate, use of admixture, temperature control, testing etc. shall be decided as per the requirement.

6.7.3 Design Consideration

Design of civil works shall be in accordance with the relevant Indian Standards. Design loading will take into consideration the following loads, as applicable:

- Dead Load
- Live load / Imposed load
- Wind load
- Seismic load
- Earth Pressure
- Temperature
- Water Pressure
- Dynamic loads
- Test loads
- Construction Load
- Mono rail load
- Crane load
- Special loads

Imposed loads considered shall be as determined by Code of Practice or as per advice by the plant design. Plant loading, lay-down, construction and maintenance loading shall be as per the load data supplied by

the plant manufacturers. Design and detailing will also take due account of locally available materials, such as bricks, aggregate, reinforcement etc. Pile system shall be provided if mandated by the Geotechnical investigation data.

6.7.4 Steam Generator Foundations

The steam generator shall be suspended from a steel structure provided by the supplier, which shall be supported on reinforced concrete foundation. The coal Conveyor Towers, Coal Bunkers, fans and Mills sited adjacent to the Boilers shall also be supported on foundations recommended by the Soil Investigation Report. The foundations to the Mills and Fan units shall include reinforced concrete blocks with anti-vibration mountings.

6.7.5 Turbine Generator Building

The function of the Turbine Generator Building is to provide support, enclosure, protection and access to the Steam turbine and auxiliary equipments.

The Turbine Generator Building is an enclosed, weather tight, steel frame structure supported on reinforced concrete footings with a ground floor concrete slab. The walls of main plant buildings consist of field erected sandwich metal wall panel, with brick wall upto a height of 3.00m from finish floor level. The superstructure will support electrical overhead traveling crane of appropriate capacity.

The foundations to the main steel frame columns and steelwork stanchions supporting major items of plant will be reinforced concrete foundation as recommended in the Geotechnical Investigation Report.

The reinforced concrete ground floor slab other than in main unloading bay will be supported on compacted fill. The ground floor slab in the main unloading bay will be thickened to form a raft slab as per requirement.

Roofing will consist of metal roof deck with reinforced concrete. Screed Concrete shall be provided over RCC slab followed by appropriate roof insulation & roof treatment. The roof will have a minimum slope adequate for drainage and will be designed to prevent ponding. The down comers shall be provided.

6.7.6 Chimney

The chimney shall be 275m high comprising a tapered cylindrical concrete windshield containing two steel flues.

The superstructure shall be supported on a reinforced concrete foundation. A concrete roof slab, with parapet formed by the windshield, shall be provided.

The flue shall be fabricated from mild steel except for the uppermost 1.5 times flue diameter of height. The top 1.5 times flue diameter shall be with acid resistant brick lining with insulation supported from the roof and will be surrounded with RCC mini shell. Lining system shall be provided to take care of the abrasion and corrosion resistance and also the effect of temperature..

The flue-shall be top hung type and restrained laterally at several levels via a system of tie beams attached to the windshield. Mineral wool mattresses secured by stainless steel bands shall be used to insulate the whole exterior of the flue.

Gas entry to the flue shall be via 2inlet ducts. Each inlet duct shall have a movement control bellows unit located just outside the windshield to isolate the chimney superstructure from other gas ducting loads. The inlet duct joining the steel flues of the chimney will be supported on the chimney foundation inside and outside the of the wind shield A suitable expansion joint shall be provided at the junction of the flue liner and inlet duct to take care of expansion . Aircraft warning lights shall be provided and fitted in accordance with Indian Civil Aviation regulations.

Steel platforms at the external wall and internal wall on a beam grid shall be installed at a minimum of five levels of the chimney to assist in maintenance of the structure and its fittings and for use in flue gas monitoring.

An electrically operated elevator with rack-and-pinion climbing track fixed to the windshield shell shall provide access to all platforms over the full height of the chimney up to the platform at about 6m below the roof level. Access from this platform to roof shall be by cage ladder. Steel staircase shall be provided for access to internal platforms upto the top most internal platform. The chimney shall be fitted with a lightning protection system.

6.7.7 Transformer Area

Transformers shall be mounted on rails supported on suitably designed reinforced concrete foundations. Reinforced concrete firewalls will be provided between transformers. Individual transformer foundation shall have its oil pit, so as to collect any spillage of oil. The oil pits shall be connected to an oil water separator pit having oily water separation/drainage system. The oil water separator pit shall have a void volume equal to 200% of total volume of oil in the Transformer. MS grating placed at the formation level inside the transformer pit shall be covered with 100mm thick gravel of 40mm size. The bottom of pit shall have uniform slope towards a common oil sump pit.

Transformer yard will be fenced with provision for gates,

6.7.8 Switchyard

The switchyard will be outdoor type, enclosed by suitable safety fencing of 2.4m high with provision of main gate and personnel gate. The yard shall contain a network of reinforced concrete cable trenches fitted with pre-cast concrete covers at ground level. Adequate drainage arrangement shall be provided in the yard to drain out storm water.

Switchyard structures including equipment supports will be of lattice type bolted and galvanized steel structures. The foundations will be of RC combined/isolated footing. Peripherals and internal roads of 3.75m wide black topping and 1.5m wide earthen shoulders on either side of the road will be provided to have access for equipment maintenance. The entire graded portion of the switchyard except roads, drains, cable trenches and buildings area shall be covered uniformly with 100mm thickness of crushed/ broken stone of 40mm nominal size (un-graded) and treated with anti weed chemicals.

6.7.9 Compressor and Diesel Generator House

The Compressor and Diesel Generator House will be a single storey steel portal framed structure housing both the compressor and diesel generator units. The roof and sidewalls will comprise of insulated profiled metal sheeting, supported by the steel superstructure. The columns will be carried on reinforced concrete foundation.

6.7.10 Coal Handling Plant

Coal handling system foundation shall be as per recommendation about type of foundation in Geotechnical Investigation Report. The Transfer points and Conveyor galleries shall be of structural steel frame with metal sheet cladding on the roof and sides. Coal handling control room shall be double storey RCC framed structure with RCC floors.

Coal handling plant shall have track hopper to receive coal through rail wagon. Coal will be crushed to require sizes in the Crusher House The crushed coal will be stacked in the Coal Stock Yard where the Stacker -Reclaimed will stack /reclaim coal

6.7.1 1 Ash handling plant

Ash handling equipment foundation shall be as per recommendation regarding type of foundation in Geotechnical Investigation Report. The pneumatic conveying pipes shall be routed on structural steel pipe racks. Ash handling compressors will be located in a RCC framed structure with RCC floors. Separate enclosure will be provided for control room in the same building. Ash slurry pump house shall be of single storey RCC framed structure with RCC floors. An under ground ash slurry sump of adequate capacity will be provided for collection and pumping of ash slurry to the ash dispoal area

Concrete Ash Silos shall be provided for storing fly dry ash for onward disposal

6.7.12 Intake Pump House & Water Conveying Structures

The pump house shall be located near the dam The pump house shall be RCC foundation and super structures will be steel structure frame enclosed with brick cladding. The monorail will be provided. Water will be pumped through steel pipes to the plant.

6.7.13 Cooling Water Pump House

The building superstructure will be RCC frame. The building along with forebay will have a basement of suitable depth constructed in reinforced concrete. The substructure will comprise of a peripheral retaining wall on a uniform thickness raft slab supporting internal columns and concrete division walls.

6.7.14 Water treatment Plant

The Water Treatment Plant (DM Plant) will be accommodated in a building of RCC construction. Roofing and side cladding will be with insulated profiled metal sheeting. Inside the building open cast foundations of reinforced concrete for various vessels and pumps/fans will be constructed.

A single storey RCC building will be constructed for DM plant MCC and control panels.

6.7.15 Workshop and Stores

The Workshop and Stores building will be a single story steel portal framed structure. The steel superstructure will be supported on reinforced concrete foundation. The roof construction will comprise multi layered insulated profiled metal cladding, supported by the steel superstructure suitable for accommodating crane .

6.7.16 Administrative-cum-Service Building

The building will be a two-storied reinforced concrete framed building. The building will house various offices and First Aid Center. A Laboratory and an Instrument Workshop will also be accommodated in the building.

The Building will be provided with suitable floor and wall finishes suitable for an office type environment. Adequate number of windows will be provided for proper ventilation and lighting. One of the rooms of the building will be used for providing canteen facility.

Concrete beams and columns on a regular grid will support the reinforced concrete roof and floor slabs. The columns will be supported on reinforced concrete foundation. The walls will be brick/concrete block masonry construction, plastered internally and rendered externally.

6.7.17 Roads

Roads inside plant area shall be of 3.75m wide asphalt topping and 1.5m wide shoulders on either side of the road. Roads inside plant area shall be with asphalt topping and shoulders on either side. Access roads to all buildings, and areas such as transformer areas and other equipment areas (where access is necessary for an inspection, operation and maintenance point of view) shall either be single or double lane road depending upon the functional requirement. Double lane roads shall be constructed with 7m wide asphalt topping and 2.5m wide shoulders on either side of the road.

Suitable pipe and RCC culverts will be provided at road crossings for drainage and cable trenches, wherever required.

6.7.18 Plant and Storm Water Drainage

The plant and storm water drainage (brick masonry/ concrete as per requirement) shall take into account the topography of the plant area, intensity of hourly rainfall and existing area drainage pattern. Of the total rainfall in the plant area, a part of it will percolate into the ground and remaining major portion will constitute the storm water. Suitable drainage of oil spillage from transformer areas fuel oil handling area including bund area etc shall be done .

The Storm water drainage system will consist of a network of open drains. Drainage from roof of all buildings will be taken down by rainwater down comers. These down comers will discharge water into open drains. The runoff from plant area, open areas, building and installation shall be carried through the network of open drains running all along the road system and finally joining the main drain.

Effluent from the battery room, fuel oil handling system and service areas will be disposed of only after suitable treatment in effluent treatment plant. In general all plant effluent drainage shall be through buried concrete pipes and all storm water drainage shall be through open drains/pipe drains as required.

6.7.19 Effluent Treatment Plants

The Wastewater Treatment structure will be a reinforced concrete multi-cell tank of adequate size. The structure will be mainly below ground. The wastewater will be collected in local or combined tanks and the effluent from these tanks will be discharged via filter drains after necessary treatment.

6.7.20 Sewerage and Sewage treatment plant

The sewerage system shall be designed to provide cleaning conduit for speedy and efficient conveyance of foul water such as wastewater from closets, urinals, baths and pantries. Independent network of lines to carry storm water drainage and sewerage shall be provided. Sewers shall be designed for a minimum self-cleansing velocity of 0.75m/sec and the maximum velocity shall not exceed 2.4 m/sec.

The plant area will be divided into different parts based on layout consideration. The sewerage flow shall be by gravity. Routing of these will ensure no interference with underground facilities. Manholes shall be provided at every 30meter along the length, at connection points and at every change of alignment, gradient or diameter of sewer pipeline.

A permanent sewage treatment plant will be provided to cater the sewage discharge of the plant area. The treatment plant shall be so designed as to meet the requirements of applicable local bylaws / pollution standards and conditions as stipulated by the Government agencies at the time of environmental clearance to the project.

6.7.21 Security Fencing

Boundary wall will be provided all round the plant periphery for security measure. Watch towers will be provided near the plant boundary. Separate Chain link fencing shall be provided in various areas e.g., Fuel gas skid area, Transformer Yard area, Open storage areas etc. in conformity with the statutory and safety requirements.

Landscaping of the entire plant area shall be carried out. It is proposed to develop green belt all around the plant boundary considering the topography of the site. Plantation of green belt shall commence at

appropriate time, so that green belt is sufficiently developed during the time of commissioning of the project.

6.7.22 Rainwater Harvesting

Rain water from various sources shall be collected and suitable arrangement for conservation and reuse shall be made.

6.8 Environmental Aspects

Environment Impact Assessment studies will be carried out by conducting a rapid EIA at the beginning of the Project, to identify the impact of the proposed power plant on the flora, fauna, human inhabitations, etc. in the surrounding area and prescribe mitigation measures. Various aspects of the environmental impact due to the proposed Power Plant are discussed below.

6.8.1 Air pollution

High efficiency Electrostatic Precipitators (ESP) shall be installed to control the emission of ash particles. The precipitators would be designed to limit the particulate emission to less than as specified by PCB / MOEF at 100% MCR. To ensure safe and optimum operation of the ESPs, each stream of precipitator would be supervised and monitored by a separate microprocessor based rapper control EP Management System (EPMS). The chimney height would be decided to meet the environmental norm. The chimney would be provided with personal access for regular monitoring of stack emissions.

For the control of fugitive dust emission within and around the coal handling plant, dust extraction and suppression systems shall be provided. Dust suppression system shall be installed at all the transfer points in Coal Handling Plant and at coal stockyard. Dust extraction system would be provided in crusher house as well. During the construction phase, no significant impact on air quality is expected. However, fugitive dust emissions and NOx levels may temporarily increase in the immediate vicinity of construction site due to soil excavation and vehicular movement. Such impacts will be confined to the construction site. These will be minimized by sprinkling water and proper maintenance of vehicles. Green belt of about 50 M or as recommended by EIA study wide will be developed all around the plant periphery to minimize dust nuisance outside the plant boundary.

6.8.2 Water pollution

Streams of effluents emanating from the power station sources during operational phase will be treated individually based on the effluent quality. Treated effluents will be collected in a Central Monitoring Basin (CMB) for final monitoring. The treated effluent will be used for green belt development and plantation work and excess water would be discharge to sea. Therefore, no appreciable impact on the ground and surface water resources is envisaged.

6.8.3 Noise Pollution

The plant is expected to increase the noise level in the surrounding due to operation of plant and machinery. Necessary noise control and abatement measures will be adopted to minimize the noise level from the plant during construction and operation phase to a maximum of 85 dBA as per the requirement of OSHA (Occupational Safety and Health Administration) Standards.

The major sources of noise during the construction phase are vehicular traffic, construction equipment like dozers, scrapers, concrete mixers, cranes, generators, pumps, compressors, rock drills, pneumatic tools, saws, vibrators, etc. The operation of these equipments will generate noise ranging between 75-90 dBA.

6.8.4 Solid Waste Management

The power plant, being coal-fired power station, would generate coarse as well as fine ash. All efforts shall be made to utilize the fly ash for various purposes. It is proposed to dispose the balance un-utilized ash to fill the identified Ash Pond.

6.8.5 Afforestation and Green Belt Development

Extensive Afforestation at plant area is planned which would not only act as lung space in the area but would also improve aesthetics and will be continued in all available space.

6.8.6 Pollution Monitoring and Control Measures

Primary impact on environment due to installation of a power plant comes from the combustion of fuel and discharge of chemicals and effluents from the plant through wastewater.

A well defined environmental monitoring programme will be provided with trained and qualified staff who will monitor the ambient air as well as stack flue gas quality to ensure that the quality of effluents are maintained within the permissible limit. The main stack will be provided with potable monitors to periodically monitor the SPM CO, NOx and SOx constituents in the flue gas on daily basis. The plant effluents will be periodically analyzed on a weekly basis so that the effluents are maintained within the permissible levels of the pollution control board regulations.

7

PERMITS AND CLEARANCES

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7.0 PERMITS & CLEARANCES

The Government of India and the associated State Government have established legal, policy and regulatory frameworks for the setting up of electricity generating stations. Accordingly, certain clearances and approvals are required to be obtained from different Government and Statutory Agencies at various stages of development and operation phase of the project. These clearances are classified into two broad categories known as statutory and non-statutory clearances.

7.1 Statutory Clearances

S. No	Description	Authority
1	Company registration	Registrar of Companies
2	NOC for setting and operation of Facility	State Pollution Control Board
3	Water availability/Water supply agreement	State Govt irrigation Dept.
4	Pollution clearance (Water and Air)	Pollution Control Board
5	Environmental and forest clearance	Ministry of Environment & Forest, Govt. of India
6	Forest clearance (if required)	State forest department
7	Civil aviation clearance for Chimney height	Airport Authority of India
8	Rehabilitation and resettlement of displaced families by land acquisition (if required)	State Govt. MOEF.
9	State/ Central Govt clearance for Mega Power project.	State / Central Govt.

Non-Statutory Clearances

S.No	Description	Authority
1	Land availability	State Government
2	Coal Mine Allocation / Fuel Linkage	Ministry of Coal and Mines, Govt. of India
3	Primary fuel supply	Respective Coal mine authorities.
4	Transportation of primary	Ministry of Industry, Ministry of Finance,

	fuel	and Govt. of India, Income Tax Authorities
5	Foreign collaboration, Foreign currency loan Foreign equity participation	
6	Clearance from Archaeological department	Govt. of India
7	Rights to access and use of site including right of way for all corridors to the Facility.	Sate Government / Concerned Agency
8	Consent of relevant Panchayat for the development of Project site and township site	Directorate of Town Planning of Local Authority

Upon getting clearance for the Project, NC ENERGY will apply for the necessary Permits and consents for the Project. The approval time for these clearances will vary from 6 to 12 months.

8

PROJECT IMPLEMENTATION

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8.0 PROJECT IMPLEMENTATION

The project is envisaged to be comprised of 4x660 MW. The Project will be executed by NC Energy Ltd (NCEL) with highly experienced team through specifically defined responsibilities. Services of qualified professional consultants will be used for the project. On completion & commissioning of the plant the operation and maintenance would be taken over by the O&M team.

8.1 Engineering

The pre-NTP and post-NTP design and engineering will be carried out by Owner's Engineer to be appointed by the project company. The Owner's Engineer as well as EPC Contractor would engage multidisciplinary experienced engineering teams at their Home offices to undertake the various tasks related to the Engineering and Design. Apart from this, they would also provide necessary engineering back up support during construction, installation and commissioning through their respective organizations at site.

The works of the Contractors for various packages would be reviewed and checked/ approved by the Owner's Engineer to ensure the following:

- Compliance to the Contract requirements
- Compliance to the various local/ statutory authorities
- Correct design and technology
- Various interfaces with different agencies

8.2 Contract Packaging

Project Company intends to implement the project either through a single EPC Contract or in separate packages, limited to 4-5 numbers of packages. The initial site development and enabling works will be carried out by the Project Company through local contractors. Indicative scope of the packages envisaged is as below:

a) EPC Package

In the EPC Package the Power Block will include Steam Generator & Auxiliaries, Steam Turbine Generator & Auxiliaries, Power Cycle equipment including BFPs, CEPs, Regenerative system LP & HP Heaters, Deaerator, HP Piping, HP & LP Bypass Systems, Station C & I and related electrical systems and Balance of Plant (BOP) will include plant electrical systems like Switchyard, HT & LT Transformers, offsite packages like Coal Handling System, coal unloading and transportation system, Ash Handling System, Water pre-treatment Plant & DM Plant, sea water intake system and CW System, Plant Miscellaneous pumps, Piping and Systems; and Civil, structural and architectural work of the plant including Civil works for BTG equipment, BOP equipment, all buildings in the plant, chimney, Cooling towers, civil works for off-shore structures, etc.

EPC Contractor shall establish a comprehensive reporting structure, which broadly includes:

- Management Reports - Progress Reports, Exception Reports, etc.
- Quality Assurance and Control Program - Shop and site
- Site Safety, Health and Environment
- Statutory Permits and Clearances

b) Incase of separate packages concept of execution, the packages will be broadly as follows:

- Boiler Island
- Turbo-generator Island
- Civil Works
- Balance of Plant (BoP) Systems with provision for splitting in to major packages.
- External rail line and In –plant railway lines
- Dam Water in-take System

c) Enabling Works:

Scope of Enabling works include land clearance, Compound wall / fencing, access roads, railway siding, construction power, construction water and other preparatory and developmental works. This will be carried out by the Project through local contractors.

The EPC Contract packages and the Enabling works packages will be developed before finalization of the Master Network Program of the project to ensure that the master network heads are developed in accordance with the list of contract packages for better monitoring.

8.3 Procurement

The contracts will be awarded through competitive bidding. List of suppliers will be selected by Owner / Owner's Engineer.

8.4 Construction

The Owner, Owner's Engineer as well as Contractors would establish site establishments with relevant experienced multidisciplinary personnel to undertake and supervise all site constructional and installation activities.

8.5 Project Schedule

The project is scheduled for the first unit to go for commissioning within 39 months from zero date followed by other units in a time gap of six (6) months. The zero date has been assumed from the date of financial closure. It is estimated that the financial closure will be achieved within six (6) months from the date of clearance.

8.6 Quality Control and Assurance

The Contractors shall follow a comprehensive Quality Assurance and Control Program for entire works. The quality control and assurance activities would be supervised by the Owner / Owner's Engineer and/ or through the appointed offsite approved agencies for the ex-site works.

8.7 Project Management

Owner's Engineer will prepare Master Schedule (L1) for the Project in the beginning of the Project. Contractors shall furnish and get approved the L2 / L3 schedules for their scope of works complying with major milestones given in L1 Schedule and strictly adhere to the same. Contractors shall furnish a monthly progress report to the Owner reflecting the scheduled dates, progress made in different activities as weighted percentage separately for Engineering, Procurement and Construction and cumulative. Contractors shall also highlight any delays / hold-ups and bring out recovery plans.

The overall project management would be undertaken by ATPPL through the Owner's Engineer. The Owner's Engineer would monitor all aspects/ critical activities of the Project and would initiate necessary activities through Contractors or other involved agencies. The Owner's Engineer would also undertake periodical reviews of the Progress & Liaise with ATPPL on any shortfalls etc.

8.8 Project Organization

During construction phase, a team of engineers headed by Site Manager of Owner supported by Owner's Engineer will supervise the activities of the Contractor.

8.9 TRAINING OF PERSONNEL

Successful plant operation and maintenance depends upon the efficiency and performance of its personnel. To achieve high degree of efficiency in plant management and operation, it is

desirable to train up personnel for the operation of the sets. The training schemes shall include:

- General theoretical training on power station operation and maintenance.
- Training of personnel with the help of computerised simulator, if such a facility is available.
- Actual in-plant training in similar power stations elsewhere.

8.9.1 General Theoretical Training

General theoretical training will include important basic theoretical knowledge of thermodynamics, power plant, electrical engineering related to thermal power station, control technology etc.

8 .9.2 Actual In-plant Training

Owner may arrange in-plant training of the personnel for the proposed power station. The operating personnel after successfully completing the training shall be posted well in advance before commissioning of the station to get thoroughly familiar with the equipment and layout of the station.

8.10 OPERATION & MAINTENANCE

8.10.1 General

The proposed plant will be operated and maintained by the Owner. Or by a reputed O&M company. The estimated regular man power is 800 approximately consisting of managers, engineers, supervisors and technicians. In addition to this regular manpower, support would be taken from maintenance contractors and local unskilled manpower for running the power station.

8.10.2 Operation

The proposed station may have high inlet steam parameters for the Boilers and Turbines, requiring advanced methods of water treatment including higher metallurgical expertise, familiarity with sophisticated instrumentation and control system and boiler/turbine management techniques.

The duties of the operation personnel will include operation of the boilers and turbines with associated auxiliaries, accessories and controls, feed water system, coal handling system, ash handling system, switchyard, chemical feed system, DM plant, compressed air plant etc.

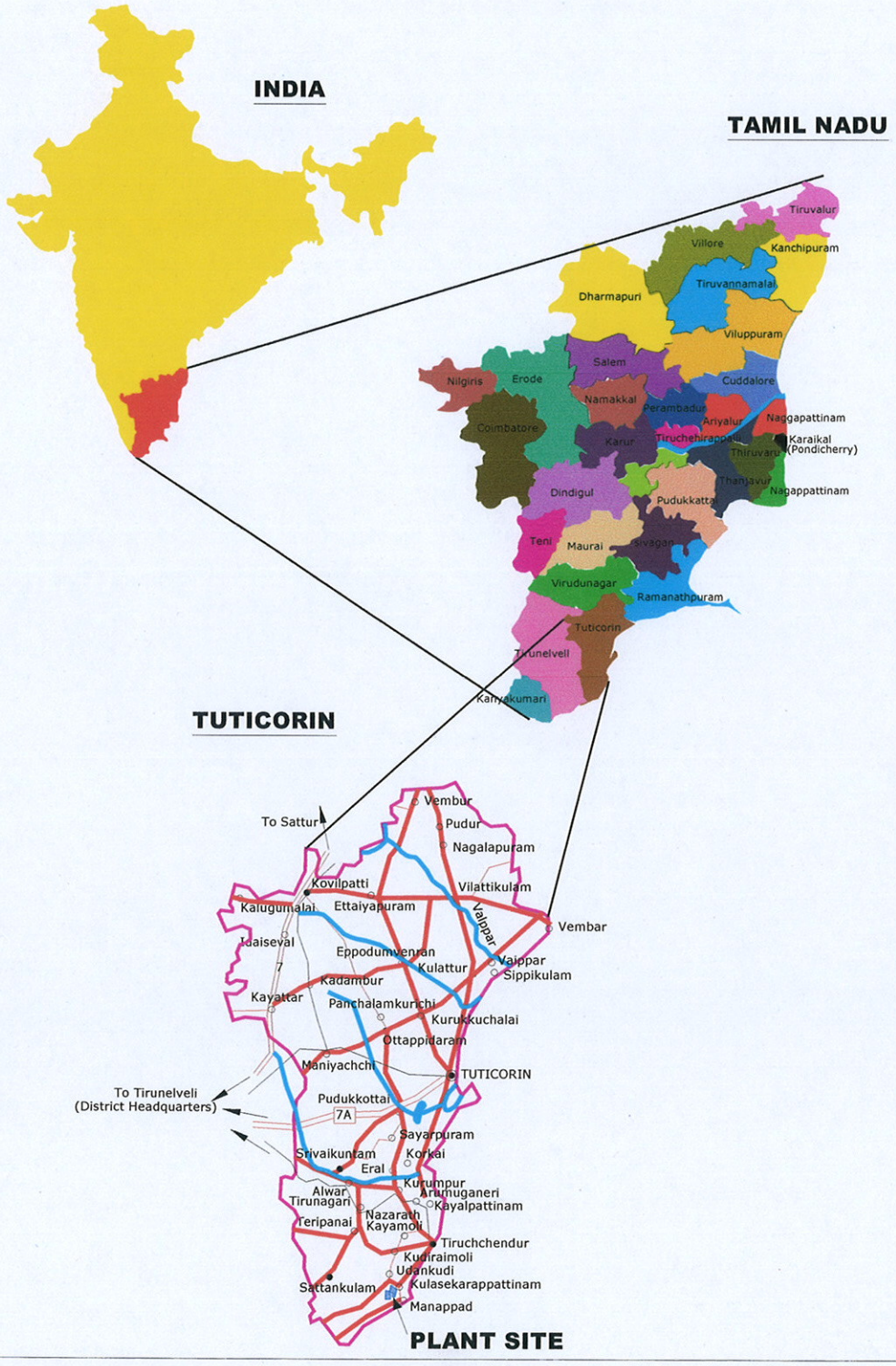
8.10.3 Maintenance

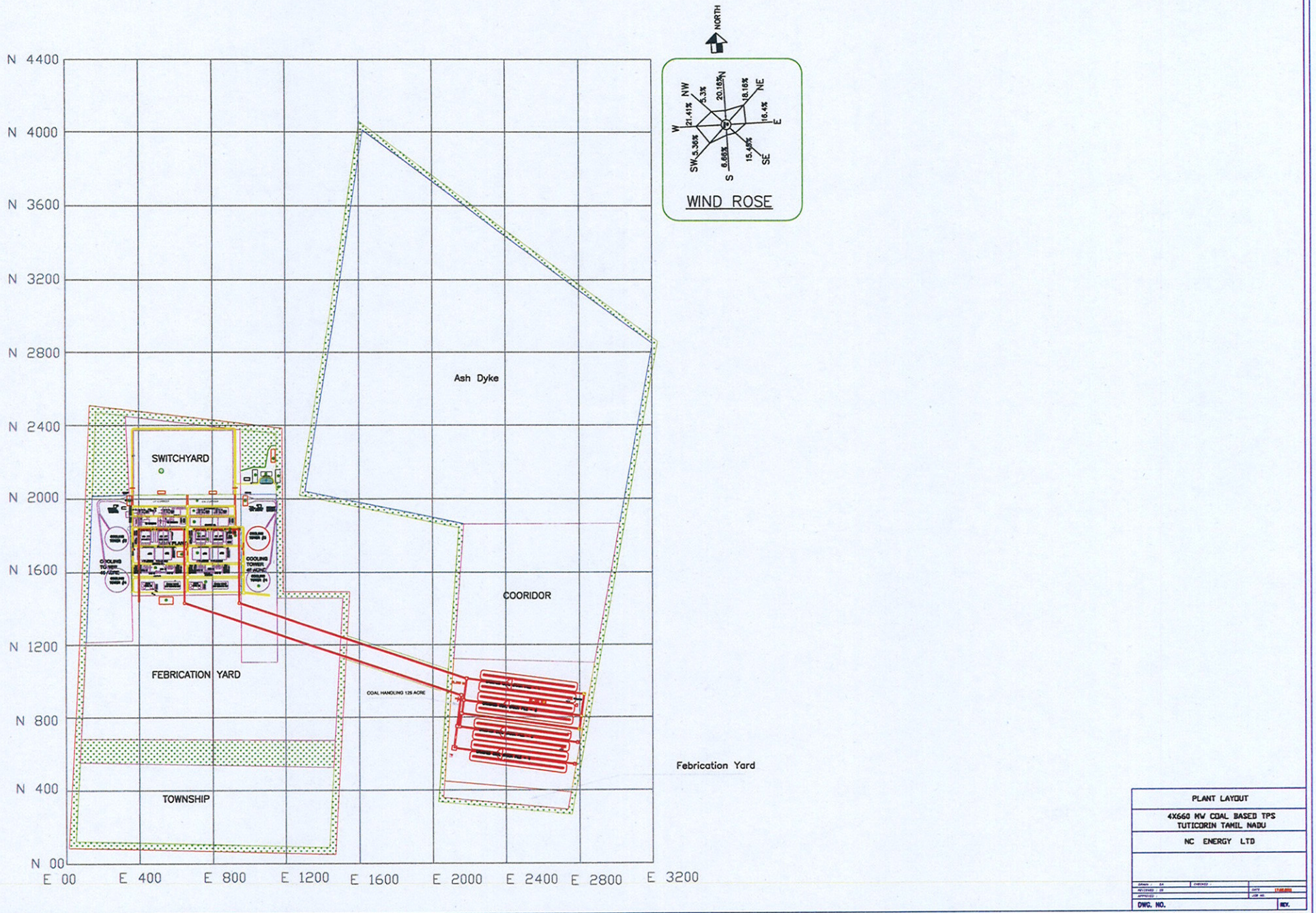
Maintenance of the plant, its mechanical, electrical, instrumentation and control equipment, management and maintenance of the chemical laboratory and the workshops, efficiency

control, quality control in matters of purchase by storage etc. are among other technical duties.

ANNEXURE - 1

LOCATION MAP

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E 2400
E 2800
E 3200
NORTH
WIND ROSE
Ash Dyke
SWITCHYARD
COORIDOR
FEBRICATION YARD
COAL HANDLING 125 ACRE
TOWNSHIP
Febrication Yard
PLANT LAYOUT
4X660 MW COAL BASED TPS
TUTICORIN TAMIL NADU
NC ENERGY LTD
DWG. NO.
REV.

ANNEXURE - 2

ANNEXURE - 3

WATER BALANCE (m^3/day)
(4 X 660 MW)

						Require-Ment	Usage (U) /Loss (L)	Waste Water
A.	**COOLING WATER**							
Cooling Water including auxiliary cooling						547456	126336	421120
B.	**NON – COOLING WATER**							
Clarifier						31424	0	31424
	Filtration					4656	0	4656
		First RO pass	Desal reject			28240	0	28240
			Misc Services			12600	12400	200
			Domestic – Plant			44	10	34
			Second RO pass			380	380	0
				DM Plant		64	0	64
					Boiler Feed	2016	2016	0
TOTAL						626880	141142	485738

Annexure - 4

COAL ANALYSIS (typical quality)

		Imported coal (Indonesia)	**Indigenous Washed Coal**	**Blend coal** (70% indigenous washed coal 30 % imported coal)
Moisture	% by wt	34	10.6	17.62
Ash Content		15	34	28.3
Volatile Matter		24.4	27.4	26.5
Fixed Carbon		26.6	28	27.58
Total Sulphur		0.6	0.3	0.39
Gross Calorific value – Air Dried	kcal/kg	**4100**	**3800**	**3890**

ANNUAL COAL REQUIREMENT

COAL		**4 x 660 MW**
Coal consumption **(Imported coal)**	TPD	35380
	*MTPA	10.96
		Or
Coal consumption **Blend coal** (70% indigenous coal and 30% imported coal)	TPD	39106
	*MTPA	12.13

*Note MTPA ; Million Tonnes per Annum (Value at 85 % PLF)

EMISSION DETAILS
(4 X 660 MW)

	IMPORTED COAL		**BLEND COAL (70 % Indigenous coal and 30 % imported coal)**	
	2 X 660 MW	**2 X 660 MW**	**2 X 660 MW**	**2 X 660 MW**
No. Of units	2	2	2	2
Coal Consumption (t/hr/unit)	368.52	368.52	407.36	407.36
Sulphur content (%)	0.60	0.60	0.39	0.39
No. Of stacks	1	1	1	1
No of Flues in each stack	2	2	2	2
Height of stack, m	275	275	275	275
Diameter of each flue(m)	7.0	7.0	7.0	7.0
Temperature of flue gas (°C)	140	140	140	140
Velocity of flue gas (m/s)	25.00	25.00	25.0	25.0
Particulate matter at outlet of ESP (gm/sec/flue) (based on 50 mg/Nm^3 at outlet)	32.32	32.32	34.9	34.9
Sulphur dioxide emission (gm/sec/flue)	1228.4	1228.4	882.6	882.6
Oxides of Nitrogen (gm/sec/flue) (based on 750 mg/Nm^3 at outlet)	485.0	485.0	523.5	523.5

ASH GENERATION
(MILLION TONES PER ANNUM)
(4 X 660 MW)

	Imported coal		**Blend Coal** (70 % Indigenous Coal and 30 % Imported coal)
Total Ash	1.64 (@15 % ash content on coal)	Or	3.43 (@28.3 % ash content on coal)
Fly Ash (@80%)	1.31		2.74
Bottom Ash (@20%)	0.32		0.69

Annexure - 5

Project Cost

Project Cost

		USD	Rs
		All figures in Crores	
1.0	**Land & Site Development**		**156.00**
1.1	Land		156.00
1.2	Resettlement & Rehabilitation		0.00
1.3	Preliminary Investigation & Site Development (Included in 4 below)		
2.0	**Plant & Equipment**		
2.1	**Steam Generator Island**		**3860.00**
2.2	**Turbine Generator Island**		**2544.00**
2.3	**Balance of Plant: Mechanical**		**1651.30**
2.3.1	Sea Water Intake System		145.00
2.3.2	Plant Water System incl. Pretreatment & DM plant		31.50
2.3.3	CW piping & pumps		59.70
2.3.4	ND Cooling Towers including civil works		300.00
2.3.5	Fuel Oil Handling & storage System		36.00
2.3.6	Coal handling system		331.50
2.3.7			
2.3.8	External Coal Transportation System		140.00
2.3.9	Make-up water pumps & piping		50.00
2.3.10	Dry AHP incl. slurry Disposal system		251.70
2.3.11	Compressed air system		61.00
2.3.12	Air conditioning & Ventilation equipment		42.00
2.3.13	Fire-fighting system		57.00
2.3.14	Cranes & Hoists		25.10
2.3.15	Workshop & Laboratory equipment		19.60
2.3.16	Effluent treatment Plant		6.50
2.3.17	Auxiliary Boiler		3.00
2.3.18	Misc.Systems & Eqpt. (Hydrogen Generation Plant, LP Piping, Valves, Insulation, painting, CPU, Cathodic Protection etc)		91.70
2.4	**Electrical**		**824.60**
2.4.1	400kV Switchyard Package		98.50
2.4.2	Generator Transformer. ICT, UT, ST incl. Bus duct		390.50
2.4.3	Switchgear package (HT, LT)including transformer		150.50
2.4.4	Cables & cable facilities		82.90
2.4.5	Lighting, grounding & Illumination and DC System		50.50
2.4.6	Emergency Power supply & DG set		24.00
2.4.7	Others (plant communication etc.)		27.70
2.4.8	400 kV Transmission line		
2.5	**Control & Instrumentation**		**41.94**
3.0	**Initial Spares**		**262.86**

INPUT

		USD	Rs.
		(All Figures are in Crores)	
A	**Total Plant & Equipment excluding civil works**		**9,340.70**
4.0	**Civil Works**		**1960.20**
4.1	Power House Boiler Area, Chimney, Stw yard & Tran. Yard		935.00
4.2	CW System, Chlorination plant, CW discharge		140.00
4.3	DM plant + Water treatment plant + eff. Treatment plant		90.00
4.4	CHP area		200.00
4.5	Ash Handling System and Ash Dyke development		150.00
4.6	Fuel Oil handling System		5.00
4.7	Township and non plant buildings		98.70
4.8	Misc. works incl. in plant roads, railway siding & drains etc.		291.30
4.9	Site enabling work		50.20
B	**Project Land & Civil & Supply Cost Excl. Taxes & Duties**		**11,300.90**
5.0	**Taxes & Duties**		**265.06**
5.1	Tax on civil works		192.64
5.2	Custom Duty		0.00
5.3	Other Taxes & Duties		72.42
6.0	**Construction & Pre Commissioning Expenses (Inclusive of Taxes)**		**1032.80**
6.1	Erection, testing & commissioning		680.00
6.2	Construction Supervision		60.00
6.3	O & M Mobilization Cost & Training		162.08
46.4	Start-up fuel		48.50
6.5	Construction Insurance		32.42
6.6	Tools & Plant		49.80
7.0	**Preliminary Expenses & Overheads (Inclusive of Taxes)**		**786.24**
7.1	Establishment Expenses		40.52
7.2	Development Expenses		360.72
7.3	Legal & Audit Expenses		20.50
7.4	Consultancy & Engineering		81.04
7.5	Contingency		283.46
C	**Project Cost excluding IDC& Financing costs**		**13,385.00**
8.0	**IDC including Working Capital Margin & Financing cost**		**1,769.40**
8.1	Financing expenses		81.04
8.2	Interest during Construction (IDC) +Working Capital Margin		1,688.36
D	**Total Project Cost including IDC & Financing Cost**		**15,154.40**

Project Particulars		
Installed Capacity of the plant	660	MW
No. of units	4	
Total Installed Capacity	2640	MW
Financial Closure (FC)/Notice to proceed (NTP)	August 2012	
Project Completion Schedule from NTP	60	months
COD of Project from NTP	August 2017	
First Financial Year	2018	
Mega Power /SEZ	Yes	
Project Life	25	years

Operational Details of the Plant		
Station Heat Rate	2291	Kcal/KWh
Auxiliary Consumption	6.50%	
Plant Load Factor	85%	
Secondary Oil Consumption	2	Ml/KWh
Base Year of O&M expenses	2011	
O&M expenses in base year (as per CERC)	0.1095	Rs. Crore / MW / Year
O&M expenses in 2011	144.54	Rs. Crore
Escalation Rate on O&M expenses (as per CERC)	4%	Per year
O&M expenses in 1st Year of Operation	169.09	Rs. Crore

Fuel Details		
Type of Coal	Domestic + Imported	
Calorific value of Coal	3430	Kcal/ Kg
Calorific Value of the secondary Oil	10000	Kcal/L
Price of Coal	1900	Rs./MT
Base year of price	2010	
Escalation Rate on Coal Price	3.0%	
Price of Secondary Oil	25	Rs./lt
Escalation Rate on secondary Fuel Price	4%	
Base year of price	2010	

Depreciation Assumption		
Depreciable Value	90%	
Normative Life of Project	25	Years
Book Depreciation Rate	3.60%	
IT Depreciation Rate	15%	WDV

Tax Assumptions		
Income Tax Rate	33.99%	
MAT Rate	11.33%	

Levellised Tariff Computation	
Discounting Factor Levellised Tariff	10.49%
Return on Enquiry	14%

Financing Details		
Debt Equity Ratio	3:1	
Equity (Rs Crores)	25%	3,788.50
Debt (Rs Crores)	75%	11,365.5
Minimum Equity Contribution	50%	
Moratorium	6	Months
Repayment Terms	10	Years
Start date of repayment	1/4/2018	
Exchange Rate	46	Rs/USD
Income Tax Holiday	10	
Interest Rate	11.50%	

Working Capital Assumptions		
Type of coal supply	Non Pit Head	
Coal Inventory	2	Month
Secondary Fuel Inventory	2	Month
O&M Expenses	1	Month
Maintenance Spares	1%	Of Completion Cost
Escalation in Maintenance Spares	6%	Per annum
Receivables	2	Months
Base Year for escalation	2017	
Interest on Working Capital	12.00%	Per annum
Working Capital Margin	25%	

First year tariff	(Rs/KWh)	Levelised tariff	(Rs/KWh)
Variable cost	1.37	Variable cost	1.69
Fixed cost	1.85	Fixed cost	1.70
Total cost	3.22	Total cost	3.39