# Tamil Nadu Generation and Distribution Corporation (TANGEDCO)
# 2 X 660 MW ENNORE SEZ STPP

## TECHNICAL SPECIFICATION
## FOR
## COAL FLOWABILITY STUDY

## SPECIFICATION NO. PE-TS-412-161-A001


**BHARAT HEAVY ELECTRICALS LIMITED**
**POWER SECTOR**
**PROJECT ENGINEERING MANAGEMENT**
**NOIDA-201301**

1.0 **SCOPE OF WORK**

A comprehensive flowability study of crushed blended and imported coal for 2x660MW Ennore SEZ STPP shall be conducted by the bidder, for the coal bunker to ensure smooth flow of coal in all seasons with different moisture contents and different percentage of fines. The bunkers are required to promote mass flow without choking and rat holing problems even with the fines content and moisture content of worst coal indicated in the specification. The report of study shall contain the followings:

a) Sample preparation & Size analysis - Preparation of required samples of coal for flowability studies, Size analysis of as received sample.

b) Moisture determination of as received coal.

c) Bulk density determination.

d) Bulk density variation with normal stress (compressibility test).

e) Coal flowability tests (Shear tests) shall be conducted for following combinations of Imported and Domestic coal:

- Best Coal – 100% Imported Coal
- Design Coal – 70% Imported & 30% Domestic Coal
- Worst Coal – 50% Imported & 50% Domestic Coal

f) The tests shall be conducted for different moisture levels (out of these one moisture level shall be as specified in the coal analysis sheet while other moisture level shall be 23%) to establish wall angle of friction against mild steel (MS), stainless steel (SS 316L), Effective angle of friction, Flow Functions, Flow Factor and Storage time effect at 24 and 72 hrs. for all flowability condition.

g) Evaluation of Mass Flow design parameters viz., slope of hopper with specified material of construction and critical outlet diameter to prevent cohesive arching.

h) Estimation of peak bunker wall pressures during filling and extraction as per IS-9178 part III standard.

i) Values of critical outlet dimensions and hopper slopes for mass flow bunkers with different moisture levels and hopper material.

2.0 The following tentative information is attached based on which flowability study for the bunker shall be conducted:-

a) Type of bunker – circular on top and conical on bottom.

b) Outlet diameter of bunker – 914 mm.

c) Maximum extraction rate of the bunker shall be considered as 63 TPH.

d) Flowability test shall be conducted considering the points indicated in Annexure – I.

e) Project Information and Coal analysis are attached as Annexure – II

f) Angle of repose – 37 degrees

g) Amount of coal per bunker – 882 Tonnes

3.0 In addition to above inputs, any other inputs required for carrying out the flowability study shall be included in bidder's offer.

4.0 Any additional measure like poking holes/flow aiding device, if required, may please be suggested with details.

## ANNEXURE – I

**Points to be considered while conducting flow-ability test**

a) Bunker will have circular cross-section and conical portion at the outlet.

b) For design of coal bins and loading hopper IS: 9178 (part I to III) shall be followed.

c) Transverse coal pressure on bunker / silo / hopper walls shall be calculated using Walker's theory and IS: 9178. The coal bunker / silo / hopper shall be designed for the following conditions :-

   i. The bunker / silo / hopper is full up to its full capacity with top surface nearly horizontal.

   ii. The bunker / silo / hopper is partially empty with the top surface of coal at an angle of repose of 37 degrees.

d) The material of construction of bunker shall be MS plate of IS: 2062, Gr. A. with 6mm thick SS 316L grade liner provided in bottom 1.0m of cylindrical portion and entire conical portion of the bunker.

e) Particle size inside the bunker shall be (-)25 mm. Flowability test shall be conducted for (-)25 mm coal size. In case it's not feasible to conduct on lumps, bidder shall conduct the test on coal fines and extrapolate their findings for lumps ( (-)25mm coal size).

f) Test shall be carried out at different moisture saturation level considering coal fines.

g) For all capacity (volume) calculation and structural design (load calculation) unit weight of coal shall be assumed as 800 kg/$m^3$ and 1200 kg/$m^3$ respectively.

# ANNEXURE - II
# (Project Information and Coal Analysis)

## 1.0 GENERAL BACKGROUND AND SALIENT FEATURES

### 1.1 Introduction

Tamilnadu Generation and Distribution Corporation owns the proposed green-field 1320 MW (2 units of 660 MW each) Coal Based Thermal Power Station at Katupalli. This is an expansion of North Chennai Thermal Power Station (NCTPS) and located on some portion of the ashdyke of NCTPS.

### 1.2 Location

The proposed site for main power plant is located near Ennore port (approx 5 kms).

The nearest Railway station is at Athipattu Pudunagar (approx 5 kms)

All weather road from Pattamandri on the Thiruvottiyur-Ponneri district highway is the nearest road access.

The nearest airport is at Chennai at a distance of 60 km.

### 1.3 Type of Plant

The proposed 2x660 MW Super-Critical Power Project consists of coal fired steam generator connected to a reheat type steam turbine generator along with all the required auxiliaries. Circulating cooling water system is envisaged for condenser cooling.

The description and salient technical data of the Steam Generator, Steam Turbine Generator, Auxiliary systems, Electrical, Control & Instrumentation, Civil etc. are explained elsewhere in the specification:

### 1.4 PROJECT INFORMATION

Project Title : **2 x 660 MW Ennore SEZ Coal Based Supercritical Thermal Power Project at Ash Dyke of NCTPS**

Owner : **TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION (TANGEDCO)**

**LOCATION**

The site is located near Vayalur Village, Ennore

| | | |
|---|---|---|
| Latitude | : | $13^0$17' N to $13^0$18' N |
| Longitude | : | $80^0$18' E to $80^0$19' E |
| Distance from Chennai City | : | 35 km |
| Nearest Airport is at Chennai at a Distance of | : | 60 km |
| Nearest Seaport is | : | Ennore |
| Nearest Railway Station is | : | Athipattu Pudunagar (approx 5 kms) |

**Meteorological Condition**

**Climate :** Tropical ,very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind.

Climatological data :

Ambient temp. ($^0$C)

| | |
|---|---|
| Annual Maximum Mean Temp | 41.5($^0$C) |
| Annual Minimum Mean Temp | 24($^0$C) |
| Design Ambient temperature | 35($^0$C) |

Relative Humidity

| | |
|---|---|
| Maximum | 100% |
| Minimum | 36% |
| Design | 75% |

Annual Rainfall

| | |
|---|---|
| Maximum | 2540 mm |
| Average | 1600 mm |
| Minimum | 1175 mm |

Prevailing Wind Direction

Nov to Jan – From NW & NE

Feb to Mar – From East & SE

Apr to May – From South & SE

June – From SW

July to Aug – From NW

Sept to Oct – From SE & SW

Wind Speed 11.8 kmph (avg)

50 kmph (max)

Seismic Zone III as per IS:1893-2002

## 1.5 Access to Site

Site is well connected to all weather road from Pattamandri on the Thiruvottiyur – Ponneri district highway. Site is located adjacent to the Chennai – Howrah broad gauge line and thus well connected by rail also.

## 1.6 Plant Rating, Capacity, Availability, PLF

Each of the two units shall have a Turbine maximum continuous rating (TMCR) of 660 MW at generator terminals based on the following site conditions.

- Ambient air temperature
- Condenser cooling water inlet temperature of 33°C and 9°C temperature rise across the condenser.
- Generator power factor of 0.85.
- Fuel specification as given elsewhere.
- Design temperature for electrical equipment is 50°C.

The VWO capacity of the steam turbine shall not be less than 105% of TMCR flow at rated parameters. Boiler maximum Continuous Rating (BMCR) will be established to match the steam flow at VWO conditions, but BMCR flow shall not less than 108% of TMCR flow.

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%.

## 1.7 Power Evacuation

Power will be evacuated from the proposed thermal power station at 400 KV voltage level through 400 KV transmission lines . The power evacuation lines would be double circuit 400 KV lines which will act as Line in & Line out circuit.

## 1.8 Site Selection

The following factors which influence the project site selection have been found very favourable to establish and operate the project.

a. Availability of fuel.
b. Existing power plant
c. Availability of adequate cooling water.
d. Availability of adequate land for locating the power plant with approach roads.
e. Suitability of land from topographical and geological aspects
f. Proximity of National Highways, Ports & Transport of fuel & heavy equipment.
g. Facility for interconnection with transmission and distribution system for evacuation of power.
h. Environmental aspects.

Total land required for the project is 500 acres which is under the possession of TANGEDCO.

## 1.9 Fuel

### 1.9.1 Source of Fuel

Domestic coal requirement for the power plant will be sourced from Kalinga block of Talcher coal fields, Mahanadi and IB valley coal fields in the state of Orissa. Coal will be transported by sea. The port of dispatch and port of receipt for domestic coal would be Paradip port and Ennore port respectively. Imported coal shall be sourced from foreign countries through sea to Ennore port.

Coal can be transported from coal mines to Ennore port by sea and unloaded at proposed coal berth-III. Further the coal can be transported to the proposed power plant through pipe conveyor which shall have a system capacity of 2 x 2000TPH.

The steam generator shall be designed for the following conditions :

- **Best Coal** – 100% Imported Coal
- **Design Coal** – 70% Imported & 30% Domestic Coal
- **Worst Coal** – 50% Imported & 50% Domestic Coal

# FUEL ANALYSIS – COAL

| DESCRIPTION ( Source / Type ) | | UNIT | DESIGN COAL (70% IMP + 30% DOMESTIC COAL) | WORST COAL (50% IMP + 50% DOMESTIC COAL) | BEST COAL (100% IMPORTED COAL) | DOMESTIC COAL ( FOR INFORMATION) |
|---|---|---|---|---|---|---|
| **PROXIMATE ANALYSIS** | | | | | | |
| Fixed carbon | | % | 34.3 | 30.22 | 40.43 | 20 |
| Volatile matter | | % | 31.22 | 27.73 | 36.45 | 19 |
| Moisture | | % | 16.35 | 16.24 | 16.5 | 16 |
| Ash | | % | 18.13 | 25.81 | 6.62 | 45 |
| Total | | % | 100 | 100 | 100 | 100 |
| HHV | | kcal / kg | 4789.4 | 4221 | 5642 | 2800 |
| LHV | | kcal / kg | | | | |
| **ULTIMATE ANALYSIS** | | | | | | |
| Carbon | | % | 50.4 | 43.91 | 60.12 | 27.7 |
| Hydrogen | | % | 3.85 | 3.49 | 4.38 | 2.6 |
| Sulphur | | % | 0.52 | 0.52 | 0.53 | 0.5 |
| Nitrogen | | % | 1.19 | 1 | 1.48 | 0.52 |
| Oxygen (difference) | | % | 9.44 | 8.82 | 10.37 | 7.26 |
| Moisture | | % | 16.35 | 16.24 | 16.5 | 16 |
| Ash | | % | 18.13 | 25.81 | 6.62 | 45 |
| Carbonates | | % | 0.11 | 0.19 | 0 | 0.38 |
| Phosphorous | | % | 0.01 | 0.02 | 0 | 0.04 |
| HARD GROVE INDEX | | | 52 | 52 | 51 | 52 |
| **ASH CHARACTERISTICS** | | | | | | |
| IT - Initial deformation temp. | | °C | 1191 | 1165 | 1230 | 1100 |
| ST - Softening temp. | H = W | °C | 1249 | 1235 | 1270 | 1200 |
| HT - Hemispherical temp. | H = W / 2 | °C | 1314 | 1310 | 1320 | 1300 |
| FT - Fusion temp. | | °C | | | | |
| **ASH CONSTITUENTS** | | | | | | |
| A - $Si\ O_2$ | | % | 43.06 | 47.77 | 36 | 59.54 |
| A - $Al_2\ O_3$ | | % | 18.43 | 21.45 | 13.9 | 29 |
| B - $Fe_2\ O_3$ | | % | 12.29 | 10.61 | 14.8 | 6.42 |
| B - CaO | | % | 9.34 | 7.1 | 12.7 | 1.5 |
| B - MgO | | % | 6.17 | 4.55 | 8.6 | 0.5 |
| B - $Na_2\ O$ | | % | 0.51 | 0.39 | 0.7 | 0.08 |
| B - $K_2\ O$ | | % | 1.19 | 0.85 | 1.7 | 0 |
| A - $TiO_2$ | | % | 1.04 | 1.2 | 0.8 | 1.6 |
| $P_2O_5$ | | % | 0.29 | 0.36 | 0.2 | 0.51 |
| $SO_3$ | | % | 7.5 | 5.42 | 10.6 | 0.25 |
| Others | | % | 0.18 | 0.3 | - | 0.6 |
| Base / Acid Ratio | | | 0.47 | 0.33 | 0.76 | 0.09 |
| $Fe_2O_3$ / CaO Ratio | | | 1.32 | 1.49 | 1.17 | 4.28 |
| Chloride | | | | | | |