

PROJECT INFORMATION



1.00.00

BACKGROUND

Chhattisgarh State Power Generation Company Limited (CSPGCL), a Govt. of Chhattisgarh Undertaking, commissioned 4x210 MW & 1x500 MW Hasdeo Thermal Power Plant together with all other infrastructures at Korba village in Korba district of Chhattisgarh in three stages i.e., Stage-I, Stage-II & Stage-III respectively using coal from Kusmunda, Junadih coal mine blocks of Coal India's South-eastern Coal Field Limited (SECL).

The Present proposal is for setting up of two (2) units of 660 MW capacity each as an extension of the existing Power Plant within the available land inside the premises of existing Plant and surrounding area.

2.00.00

LOCATION AND APPROACH

The Hasdeo Thermal Power Station project is located at Korba Village in Korba District of Chhattisgarh. Access to the Project Site by Road is through State Highway No. 39 from Raipur and Bilaspur.

The Site is located at latitudes of 22°24'38.5" N and longitudes of 82°41'39" E, respectively.

The nearest airport is Swami Vivekanand Airport at Raipur at about 214 Km from the project site. Other Major Towns / City nearer to the Project site are Korba at about 10 Kms, Champa at about 45 Kms and Bilaspur at about 125 Kms.

2.01.00

RAIL LINK

Nearest railway station is Korba railway station, located on Gevra Road – Champa section under Bilaspur railway division of South-East Central Railway zone.

2.02.00

AIRPORT

The nearest commercial airport is Swami Vivekanand Airport, Raipur which is at a distance of 214 Kms from the Project site.

The vicinity Plan is placed in **Annexure-I**.

3.00.00

CAPACITY

| | | |
|-----------|---|--|
| Stage-I | : | 420 MW (2x210 MW) – Under commercial Operation |
| Stage-II | : | 420 MW (2x210 MW) – Under commercial Operation |
| Stage-III | : | 500 MW (1x500MW) – Under commercial Operation |
| Stage-IV | : | 1320 MW (2x660 MW) – Present Proposal |

Ultimate Capacity : 2660 MW (After installation of proposed units)

4.00.00

LAND

The expansion project is envisaged to be accommodated in the available unutilized land of approx. 187 Acres within existing premises of HTPS, Korba west. Additional land of approx. 124

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Acres adjacent to Plant boundary on the southern side shall be acquired for railway siding and CHP facilities.

5.00.00 WATER

Water requirement for the proposed project would be about 40 Cusec. Water requirement for the project will be met from upstream of Hasdeo barrage on the Hasdeo river. Water shall be pumped from raw water pumps house, located at Hasdeo river, to PT Plant and Ash handling Plant through raw water pipelines.

Water cooled Condenser with closed cycle cooling water system and Natural Draft Cooling Tower (NDCT) is envisaged for the proposed units.

6.00.00 COAL

6.01.00 The coal requirement for the project is estimated at about 6.5 MTPA corresponding to 85% PLF considering GCV of 3300 Kcal/Kg.

6.02.0 Coal Transportation

The coal shall be transported primarily to the proposed project through Rail Mode.

Two (2) nos. long distance coal conveyors (LDCC) available for the existing 4x210 MW units shall also be utilized after due renovation & modernization for coal transportation from newly constructed 20000 MT coal bunker at SECL mine for the proposed 2x660 MW units. For this additional, 02 nos interconnections from Existing Coal stackyard shall be provided.

6.03.00 Coal Quality

The primary fuel for the main steam generator shall be coal. The coal quality parameters indicated in **Annexure-IV-2** are to be considered for steam generator design.

7.00.00 Fuel Oil

The fuel oil to be used for start-up, coal flame stabilization and low load operation of the steam generator shall be Light Diesel Oil having the characteristics given in **Annexure-IV-1**.

8.00.00 MODE OF OPERATION : Middle load (two shifting and load cycling)

9.00.00 STEAM GENERATOR TECHNOLOGY

The steam generators shall be super critical, once through, water tube type, direct pulverized coal fired, top supported, balanced draft furnace, single reheat, radiant, dry bottom type, suitable for outdoor installation. The gas path arrangement shall be single pass (Tower type) or two pass type.

10.00.00 FLUE GAS DESULPHURIZATION SYSTEM (FGD) AND DENOX READY:

The project is envisaged with environmental emission control devices and steam generator design towards compliance with the applicable emission norms. The secondary NOx control system (SCR/SNCR or a hybrid of both) is not included in the

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scope of this contract. Necessary provisioning as detailed in specifications shall however be in the scope of the Contractor. The limestone to be used for the design of the FGD system shall be as per the characteristic given in **Annexure-IV-5**.

11.00.00 CONSTRUCTION POWER

Construction power shall be taken from the 11KV substation inside the plant boundary provided at one location by the employer. The bidder has to tap off the Supply from the proposed 11KV substation and suitably rated 11/11.5KV transformers and associated 11KV RMU Panels, HT cables, LT cables and modifications required in existing 11KV feeders etc. is also in the scope of Bidder. A power line ring main will be constructed at 11kV encompassing the construction area for feeding construction power at pre-determined locations where it will be stepped down to 415 V. The Contractor will be provided power connection at 415 V for them to supply power to various work centres.

12.00.00 POWER EVACUATION SYSTEM

Power generated from the proposed 2x660 MW units would be evacuated at 400 kV level through new/ existing lines. For this, a new 400 kV switchyard will be constructed to accommodate the following bays required for proposed units' Power evacuation.

- Two (2) – 400 kV circuits for Generator Transformers
- Two (2) – 400 kV circuits for Station Transformers
- Three (3) – 400 kV circuits for outgoing lines to nearest Grid S/S. (2 for outgoing line for two units & 1 for interconnection with existing 400kV Switchyard of Stage- III)
- One (1) – 400 kV circuit for Bus reactor.

13.00.00 PLANT WATER SCHEME

The Plant water scheme is described below.

13.01.00 Equipment Cooling Water (ECW) System

All plant auxiliaries shall be cooled by De-mineralized water (DM) in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from CW system in a closed secondary circuit. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system.

It is proposed to provide independent primary cooling water circuit for TG & its auxiliaries and Steam Generator & auxiliaries (including station auxiliaries) on Unit basis.

13.02.00 Condenser Cooling (CW) Water System

It is proposed to adopt a recirculating type cooling water system with cooling towers for the project. For the re-circulating type CW system, it is proposed to supply

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clarified water as make up. Circulating water from CW pumps to TG area and from TG area to cooling tower will be carried through pipes/ducts. Cooled water from cooling tower will be led to CW pump house through the cold water channel by gravity.

To reduce the Suspended Solids in the cooling water, Circulating Water shall be passed through Automatic Valve less Gravity Filter Units (SSF system). After filtration, the filtered water will be returned to the CW Channel under gravity. Required pumping system shall be installed to pump the circulation water from SSF feed sump to filter units.

The Plant water scheme is a part of tender drawing which is to be included in **Part E**.

13.03.00 Other Miscellaneous Water Systems

CW system blow down water shall be used for the FGD process requirement, ash slurry pumps sealing, sealing of Vacuum pumps (if applicable) of Ash Handling plant, make-up to fire water system. The service water shall be taken from clarified water tank of Pre-treatment plant and also from treated water of plant wastewater. The service (wash water) water collected from various areas and coal handling plant shall be treated as per requirement and reused. The drinking water requirement shall be provided from water treatment plant.

The quality of Raw water is given in this sub-section at **Annexure-III**.

14.00.00 ENVIRONMENTAL ASPECTS

The upcoming units are proposed to be constructed on the land already acquired for ultimate capacity of HTPS, which conforms to the siting criteria for thermal power plants. Environment Clearance for proposed units has already been applied and expected to be accorded by MOEF&CC soon.

15.00.00 METEOROLOGICAL DATA

The meteorological data from nearest observatory is placed at **Annexure-II**.

16.00.00 CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in Part-B Civil Works D-1-12(E) of this section.

17.00.00 CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in Part-B Civil Works D-1-12(D) of this section.

18.00.00 Vulnerability Atlas of India (VAI), prepared by Building Materials, Training and Promotion Council (BMTPC) under Ministry of Housing and Urban Affairs, is a

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comprehensive document which provides existing hazard scenario for the entire country and presents the digitized State/UT-wise hazard, maps with respect to earthquakes, winds and floods for district-wise identification of vulnerable areas. It also includes additional digitized maps for thunderstorms, cyclones and landslides. The main purpose of this Atlas is its use for disaster preparedness and mitigation at policy planning and project formulation and construction stage. The VAI provides necessary information for risk analysis and hazard assessment and is available at website www.bmtpc.org.

As per Government's directive, it is mandatory for the bidders to refer VAI for multi-hazard risk assessment and include the relevant hazard proneness specific to project location while planning, designing and execution of the project in terms of following details:

- i) Seismic zone (II to V) for earthquakes
- ii) Wind velocity
- iii) Area liable to floods and Probable max. surge height
- iv) Thunderstorms history
- v) Number of cyclone storms/sever cyclone storms and max sustained wind specific to coastal region
- vi) Landslides incidences with Annual rainfall normal
- vii) District wise Probable Max. Precipitation

Accordingly, bidder should refer VAI while planning, designing and execution of the project.

However, for design of structures/facilities and equipment, the criteria for earthquake resistant design of structures and equipment, the criteria for Wind Resistant Design of Structures and Equipment and design parameters for drainage facilities, stipulated in the Technical Specification shall be followed.

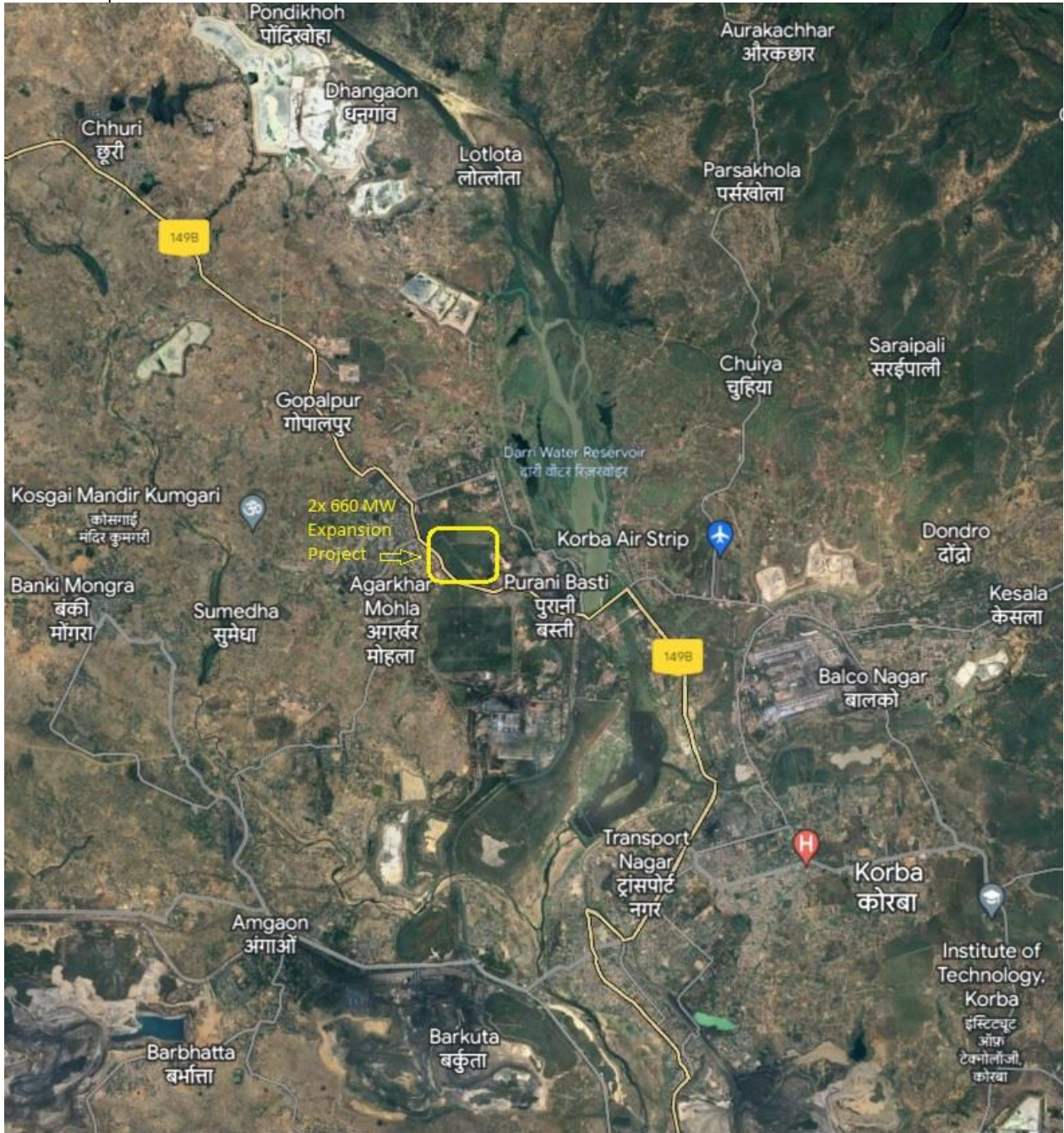
For other information like area liable to floods, probable max. surge height, landslide, thunderstorm, cyclone etc. agencies are required to refer the VAI.

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Annexure-I

VICINITY MAP



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Annexure-II

CLIMATOLOGICAL DATA STATION: IMD - AMBIKAPUR

| <i>Month</i> | Atmospheric Pressure (mb) | | Temperature (°C) | | Relative Humidity (%) | | Rainfall (mm) |
|--------------|----------------------------------|-------------|-------------------------|------------|------------------------------|-----------------|----------------------|
| | 0830 | 1730 | Max | Min | Mean Max | Mean Min | |
| January | 947.9 | 945.1 | 27.6 | 4.8 | 77 | 50 | 25.8 |
| February | 946.3 | 943.5 | 31.5 | 7.2 | 67 | 40 | 20.1 |
| March | 944.5 | 941 | 37 | 11.5 | 51 | 29 | 19.5 |
| April | 941.8 | 937.9 | 41.1 | 16.6 | 39 | 23 | 13.6 |
| May | 938.1 | 934.3 | 42.8 | 20.6 | 43 | 28 | 21.3 |
| June | 934.7 | 931.8 | 41.9 | 21.4 | 66 | 55 | 235 |
| July | 934.6 | 932.4 | 34 | 21.4 | 86 | 81 | 411.2 |
| August | 935.5 | 933.2 | 32.4 | 21.5 | 88 | 83 | 352.2 |
| September | 939 | 936.4 | 32.5 | 20 | 86 | 79 | 227 |
| October | 944.2 | 941.5 | 31.9 | 13.4 | 79 | 64 | 48.4 |
| November | 947.2 | 944.5 | 29.1 | 8.7 | 77 | 57 | 14 |
| December | 948.5 | 945.6 | 26.4 | 5.5 | 77 | 54 | 11.2 |
| Total | | | | | | | 1399.3 |

Source: Climatological Norms 1981-2010

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NORMALS AND EXTREMES OF RAINFALL KORBA

| STATION | No. of Years of Data | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | ANNUAL | ANNUAL RAINFALL AS % OF NORMAL & YEARS** | | HEAVIEST RAINFALL IN 24 HOURS* | | |
|------------------|----------------------|-----|------|------|------|------|------|-------|-------|-------|-------|------|------|--------|--|--------|--------------------------------|-------|-------------|
| | | | | | | | | | | | | | | | HIGHEST | LOWEST | AMOUNT (mm) | DATE | |
| Kartala | 10 | a | 7.4 | 8.0 | 7.9 | 3.2 | 1.1 | 160.9 | 450.2 | 383.8 | 224.9 | 63.1 | 8.9 | 2.3 | 1321.7 | 134 | 82 | 207.5 | 30 Jun 2005 |
| | | b | 0.4 | 0.7 | 0.8 | 0.4 | 0.1 | 6.8 | 18.0 | 15.6 | 10.6 | 2.9 | 0.4 | 0.3 | 57.0 | (2003) | (2006) | | |
| Kathgora | 48 | a | 13.9 | 13.2 | 10.5 | 6.7 | 11.4 | 201.5 | 448.3 | 429.7 | 228.1 | 46.6 | 10.8 | 5.6 | 1426.3 | 200 | 54 | 433.6 | 24 Nov 1958 |
| | | b | 1.0 | 1.0 | 0.9 | 0.7 | 0.8 | 8.2 | 18.0 | 16.8 | 11.1 | 2.3 | 0.5 | 0.3 | 61.6 | (1961) | (1979) | | |
| Korba | 23 | a | 20.1 | 12.8 | 5.6 | 29.0 | 7.6 | 206.1 | 492.3 | 472.7 | 237.4 | 56.4 | 12.5 | 10.6 | 1563.1 | 205 | 67 | 358.0 | 12 Aug 2004 |
| | | b | 0.6 | 0.9 | 0.3 | 0.1 | 0.4 | 8.5 | 17.2 | 15.7 | 10.1 | 3.1 | 0.7 | 0.6 | 58.2 | (1988) | (1993) | | |
| Kotaghat | 27 | a | 13.6 | 19.6 | 12.2 | 12.5 | 6.9 | 182.3 | 344.1 | 396.1 | 175.1 | 37.5 | 6.6 | 12.5 | 1219.0 | 154 | 50 | 224.0 | 01 Aug 1969 |
| | | b | 1.2 | 2.0 | 1.1 | 1.1 | 0.6 | 8.4 | 16.4 | 17.0 | 9.7 | 2.5 | 0.4 | 0.5 | 60.9 | (1961) | (1965) | | |
| Pali | 11 | a | 12.8 | 6.2 | 3.0 | 2.3 | 5.4 | 144.1 | 413.4 | 347.1 | 257.0 | 46.8 | 1.7 | 0.0 | 1239.8 | 140 | 83 | 195.0 | 06 Aug 2005 |
| | | b | 0.5 | 0.6 | 0.3 | 0.3 | 0.7 | 7.4 | 15.4 | 13.4 | 9.9 | 2.1 | 0.2 | 0.0 | 50.8 | (2001) | (2009) | | |
| Korba (District) | | a | 13.6 | 12.0 | 7.8 | 10.7 | 6.5 | 179.0 | 429.7 | 405.9 | 224.5 | 50.1 | 8.1 | 6.2 | 1354.1 | 236 | 56 | | |
| | | b | 0.7 | 1.0 | 0.7 | 0.5 | 0.5 | 7.9 | 17.0 | 15.7 | 10.3 | 2.6 | 0.4 | 0.3 | 57.6 | (1988) | (1979) | | |

a: Normal rainfall in mm.
b: Average number of rainy days (i.e. days with rainfall of 2.5 mm or more)
* Based on all available data.
** Years of occurrence given in brackets.

PROJECT INFORMATION**Frequency of Annual Rainfall in the District****KORBA****(Data 1961-2010)**

| Range in mm | No. of years | Range in mm | No. of years |
|-------------|--------------|-------------|--------------|
| 701 – 800 | 1 | 2001 – 2100 | 0 |
| 801 – 900 | 0 | 2101 – 2200 | 1 |
| 901 – 1000 | 2 | 2201 – 2300 | 0 |
| 1001 -1100 | 2 | 2301 – 2400 | 1 |
| 1101-1200 | 6 | 2401 – 2500 | 0 |
| 1201-1300 | 6 | 2501 – 2600 | 0 |
| 1301-1400 | 4 | 2601 – 2700 | 0 |
| 1401-1500 | 5 | 2701 – 2800 | 0 |
| 1501-1600 | 4 | 2801 – 2900 | 0 |
| 1601-1700 | 2 | 2901 – 3000 | 0 |
| 1701-1800 | 2 | 3001 - 3100 | 0 |
| 1801-1900 | 1 | 3101 – 3200 | 1 |
| 1901-2000 | 1 | | |

(Data available for 39 years)*Source : IMD CLIMATOLOGICAL SUMMARIES OF STATES series 22*

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Annexure-III

RAW WATER ANALYSIS

| SI No. | Parameters | Unit | Results |
|--------|--------------------------------|---------------------------|----------|
| 1 | pH | | 6.5-8.0 |
| 2 | Turbidity | NTU | 10-1200 |
| 3 | P-Alkalinity | mg/l as CaCO ₃ | 12 |
| 4 | M-Alkalinity | mg/l as CaCO ₃ | 73 |
| 5 | Calcium | mg/l as CaCO ₃ | 57 |
| 6 | Magnesium | mg/l as CaCO ₃ | 27 |
| 7 | Chloride | mg/l as Cl | 14 |
| 8 | Sulphate | mg/l as SO ₄ | 16 |
| 9 | Colloidal Silica | mg/l as SiO ₂ | NA |
| 10 | Reactive Silica | mg/l as SiO ₂ | 16 |
| 11 | Sodium + Potassium | mg/l | 19 |
| 12 | Total Organic Carbon (TOC) | mg/l | 20 |
| 13 | Chemical Oxygen Demand (COD) | mg/l | 30 |
| 14 | Biological Oxygen Demand (BOD) | mg/l | 5 |
| 15 | Equivalent Mineral Acid (EMA) | mg/l | 27 |
| 16 | Total Suspended Solids (TSS) | mg/l | 5-1000 |
| 17 | Total Iron | mg/l as Fe | 0.5 |
| 18 | KMnO ₄ No | mg/l | 16-50 |
| 19 | Dissolved Oxygen (DO) | mg/l | 6-8 |
| 20 | Sp Conductivity | (micro siemens/cm) | UPTO 220 |
| 21 | TDS | mg/l | UPTO 150 |
| 22 | TOTAL ANIONS | mg/l | 103 |
| 23 | TOTAL CATIONS | mg/l | 103 |
| 24 | Temperature | Deg C | 18-36 |

ANNEXURE-IV-1

LIGHT DIESEL OIL CHARACTERISTICS

AS PER IS 15770-2008

| Characteristics | LDO |
|--|---|
| 1. Pour Point (max) | 21 °C & 12°C for Summer and Winter respectively |
| 2. Kinematic viscosity in centistokes at 40 deg.C | 2.5 to 15.0 |
| 3. Sediment percent by mass (max) | 0.10 |
| 4. Total sulphur percent by mass (max) | 1.5 |
| 5. Ash percentage by mass (max) | 0.02 |
| 6. Carbon residue (Rams bottom) percent by mass (max.) | 1.50 |
| 7. Acidity inorganic | Nil |
| 8. Flash point (Min.) - Pensky Martens | 66°C |
| 9. Copper strip corrosion for 3 hours at 100°C | Not worse than No. 2 |
| 10. Water content, % by volume (max) | 0.25 |
| 11. GCV(kcal/kg) | 10,000 |

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ANNEXURE-IV-2

DOMESTIC COAL CHARACTERISTICS

| Sl. No. | Characteristics | Unit | Design Coal | Worst Coal | Best Coal | Range of Adequacy Coal |
|------------|---|---------|-------------|------------|-----------|------------------------|
| 1.0 | PROXIMATE ANALYSIS (As received basis) | | | | | |
| 1.1 | Total Moisture | % | 12.0 | 14.0 | 11.0 | 9.0 – 15.0 |
| 1.2 | Ash | % | 42.0 | 43.0 | 37.0 | 35.0 – 48.0 |
| 1.3 | Volatile Matter | % | 20.0 | 19.0 | 21.5 | 19.0 – 25.0 |
| 1.4 | Fixed Carbon | % | 26.0 | 24.0 | 30.5 | 25.0 – 33.0 |
| 1.5 | Total | % | 100 | 100 | 100 | |
| 2.0 | ULTIMATE ANALYSIS (As received basis) | | | | | |
| 2.1 | Carbon | % | 33.94 | 31.93 | 37.90 | 31.00 – 42.00 |
| 2.2 | Hydrogen | % | 2.69 | 2.50 | 3.23 | 2.50 – 3.30 |
| 2.3 | Nitrogen | % | 00.77 | 00.64 | 00.93 | 00.49 – 00.93 |
| 2.4 | Oxygen | % | 7.59 | 6.98 | 8.94 | 5.19 – 8.94 |
| 2.5 | Sulphur | % | 00.51 | 00.35 | 00.60 | 00.35 – 00.60 |
| 2.6 | Total Moisture | % | 12.00 | 14.00 | 11.00 | 9.00 – 15.00 |
| 2.7 | Ash | % | 42.00 | 43.00 | 37.00 | 35.00 – 48.00 |
| 2.8 | Mineral | % | 00.50 | 00.60 | 00.40 | 00.20 – 01.00 |
| 2.9 | Total | % | 100 | 100 | 100 | |
| 2.10 | GCV | Kcal/Kg | 3300 | 3100 | 3750 | 2800 – 4000 |
| 2.11 | Hard Grove Index | HGI | 50 | 47 | 58 | 47 – 62 |
| 2.12 | YGP Index (min.) | mg/kg | 80 | 65 | 84 | 65 – 84 |
| 3.0 | ASH ANALYSIS | | | | | |
| 3.1 | Silica (SiO ₂) | % | 65.55 | 66.23 | 65.50 | 64.20 – 67.20 |
| 3.2 | Alumina (Al ₂ O ₃) | % | 25.83 | 25.10 | 25.43 | 24.00 – 26.69 |
| 3.3 | Iron Oxide (Fe ₂ O ₃) | % | 4.14 | 3.80 | 4.55 | 3.33 – 4.55 |

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| Sl. No. | Characteristics | Unit | Design Coal | Worst Coal | Best Coal | Range of Adequacy Coal |
|------------|---|--------|-------------|------------|-----------|------------------------|
| 3.4 | Titania (TiO ₂) | % | 1.47 | 1.75 | 1.10 | 1.08 – 1.75 |
| 3.5 | Phosphoric Anhydride | % | 00.47 | 00.73 | 00.41 | 00.41 – 00.89 |
| 3.6 | Lime (CaO) | % | 00.71 | 00.48 | 00.89 | 00.38 – 00.91 |
| 3.7 | Magnesia (MgO) | % | 00.42 | 00.52 | 00.25 | 00.24 – 00.75 |
| 3.8 | Sulphuric Anhydride | % | 00.34 | 00.43 | 00.25 | 00.15 – 00.43 |
| 3.9 | a) Sodium Hydroxide (Na ₂ O) Max. | % | 00.10 | 00.06 | 00.31 | 00.04 – 00.45 |
| | b) Potassium Oxide (K ₂ O) by difference | % | 00.97 | 00.90 | 01.31 | 00.90 – 1.31 |
| 4.0 | ASH FUSION RANGE (Under reducing atmosphere) | | | | | |
| 4.1 | Initial Deformation Temperature (IDT) | Deg. C | 1150 | - | - | 1100 – 1450 |
| 4.2 | Hemispherical Temperature | Deg. C | 1400 | - | - | 1280 – 1400 |
| 4.3 | Flow Temperature | Deg. C | 1400 | - | - | 1280 – 1400 |

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ANNEXURE-IV-3

HIGH SPEED DIESEL OIL CHARACTERISTICS

[AS PER IS 1460-2005 (BS-II)]

| S. No. | Particulars | Unit | Value |
|---------------|---|-------------------|--------------|
| 1. | PHYSICAL PROPERTIES | | |
| | a. Distillation volume recovery @ 350°C | % vol. (min) | 85 |
| | b. Distillation volume recovery @ 370°C | % vol. (min) | 95 |
| | c. Kinematic Viscosity @ 40 °C | cSt | 2.0 – 5.0 |
| | d. Density @ 15 Degree C | kg/m ³ | 820 – 860 |
| | e. Pour Point | | |
| | - Summer | °C (max) | 15 |
| | - Winter | °C (max) | 03 |
| | f. Cold Filter Plugging Point | | |
| | - Summer | °C (max) | 18 |
| | - Winter | °C (max) | 06 |
| | g. Flash Point (Abal) | °C (max) | 35 |
| | h. Lubricity WSD 1.4 @ 60 °C | °C (max) | 460 |
| | | Microns (max) | |
| 2. | HEATING VALUE | | |
| | a. Higher Heating Value (HHV) | Kcal/Kg | 11,000 |
| | b. Lower Heating Value (LHV) | Kcal/Kg | 10,300 |
| 3. | ACIDITY | | |
| | a. Inorganic | mg KOH/g | Nil |
| | b. Total | mg KOH/g | 0.2 (max.) |
| 4. | Copper Strip Corrosion 3 hours @100°C | No. | 1 (max) |
| 5. | RCR on 10% residue | % wt. | 0.3 (max) |
| 6. | CONTAMINANTS | | |
| | a. Ash | ppm (wt.) | 100 (max) |
| | b. Sediments | % wt | 0.05(max) |

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|----|------------------------|----------|-----------|
| | c. Total Sulphur | % wt | 0.05(max) |
| | d. Water Content | % volume | 0.05(max) |
| | e. Trace Metals | | |
| | - Na + K | ppm (wt) | 0.30(max) |
| | - Vanadium | ppm (wt) | 0.50(max) |
| | - Lead | ppm (wt) | 0.50(max) |
| | - Calcium | ppm (wt) | 2.0 |
| | - Ni + Zn | ppm (wt) | Nil |
| 7. | Nitrogen content (FBN) | % wt. | 0.015 |

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ANNEXURE-IV-4

| TYPICAL IMPORTED COAL AND ASH CHARACTERISTICS | | | |
|--|--|----------------------|-------------|
| Sl.No. | Characteristics | Imported Coal | |
| | (as received basis) | | |
| | | Worst | Best |
| 1.0 | Proximate Analysis | | |
| 1.1 | Total Moisture (%) | 20 | 16 |
| 1.2 | Ash (%) | 10 | 10 |
| 1.3 | Volatile Matter (%) | 30 | 45 |
| 1.4 | Fixed Carbon (%) | 40 | 29 |
| 1.5 | Total (%) | 100 | 100 |
| 2.0 | Ultimate Analysis | | |
| 2.1 | Carbon (%) | 56.4 | 62.4 |
| 2.2 | Hydrogen (%) | 4.5 | 4.9 |
| 2.3 | Sulphur (%) | 0.9 | 0.8 |
| 2.4 | Nitrogen (%) | 0.9 | 0.5 |
| 2.5 | Oxygen (%) (By difference) | 7.3 | 5.4 |
| 2.6 | Carbonates (%) | 0 | 0 |
| 2.7 | Phosphorous (%) | 0 | 0 |
| 2.8 | Total Moisture (%) | 20 | 16 |
| 2.9 | Ash (%) | 10 | 10 |
| | Total | 100 | 100 |
| 2.10 | GCV (Kcal/Kg) | 5800 | 6500 |
| 2.11 | Hard Grove Index | 45 | 60 |
| 2.12 | YGP (mg/kg) | 100 | 70 |
| 3.0 | Ash Analysis | | |
| 3.1 | Silica (SiO ₂) (%) | 32.74 | 34.94 |
| 3.2 | Alumina(Al ₂ O ₃) (%) | 30.5 | 28.43 |
| 3.3 | Iron Oxides(Fe ₂ O ₃) (%) | 18.2 | 15.2 |

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| | | | |
|------------|--|------|------|
| 3.4 | Titania (TiO ₂) | 1.56 | 1.76 |
| 3.5 | Phosphoric Anhydride(P ₂ O ₅) (%) | 0.44 | 0.54 |
| 3.6 | Lime (CaO) (%) | 6.12 | 7.62 |
| 3.7 | Magnesia (MgO) (%) | 1.83 | 1.93 |
| 3.8 | Sulphuric Anhydride (%) | 6.95 | 7.65 |
| 3.9 | Sodium Oxide (Na ₂ O) (%) | 0.3 | 0.4 |
| 3.10 | Balance alkalies (by difference) | 1.36 | 1.56 |
| | Total | 100 | 100 |
| 4.0 | Ash Fusion Temperature | | |
| | reducing temperature | | |
| 4.1 | Initial deformation Temp (°C) | 1100 | 1250 |
| 4.2 | Hemispherical Temp. (°C) | 1300 | 1350 |
| 4.3 | Flow Temp. (°C) | 1400 | 1400 |

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ANNEXURE-IV-5

LIMESTONE CHARACTERISTICS

| Chemical Analysis (% by mass) | | | |
|--------------------------------------|--------------------------------|----------|-----------|
| 1. | CaO | % | 47-51.0* |
| 2. | MgO | % | 0.9-2.0 |
| 3. | Fe ₂ O ₃ | % | 0.45-1.0 |
| 4. | Al ₂ O ₃ | % | 1.19-2.1 |
| 5. | Si ₂ O ₃ | % | 2.1-4.5 |
| 6. | Mn ₂ O ₃ | % | <0.12 |
| 7. | P ₂ O ₅ | % | Traces |
| 8. | Cl ₂ | % | <0.015 |
| 9. | Na ₂ O | % | <0.16 |
| 10. | K ₂ O | % | <0.01 |
| 11. | TiO ₂ | % | <0.02 |
| 12. | Total Sulphur | % | <0.1 |
| 13. | LOI | % | 39.0-41.3 |
| Physical Properties | | | |
| 1. | Bond Index | kWh/sh.T | 13 |
| 2. | Granule Size | | Medium |

Notes:

- *Guaranteed parameters (guarantee on limestone consumption, auxiliary power consumption & gypsum purity) shall be based on available (reactive) CaCO₃ content of 89%. The design of Flue Gas Desulphurisation (FGD) system & auxiliaries shall be based on available (reactive) CaCO₃ content of 79%.
- For the purpose of volumetric computations of limestone handling & storage system the bulk density of limestone shall be taken as 1400 kg/m³. However, for torque, drive & structural load requirements the density of lime stone shall be taken as 1700 kg/m³. For density calculation of Limestone slurry, density of

PROJECT INFORMATION



limestone shall be taken as 2700 Kg/m³. For gypsum, the bulk density shall be taken as 900 kg/m³ for volumetric computation and 1250 kg/m³ for torque, drive & structural load requirements. For density calculation of Gypsum slurry, density of Gypsum shall be taken as 2500 Kg/m³.

3. For the purpose of sizing of equipments and guarantee, MgCO₃ shall be considered as unreactive dolomitic form.
4. The above represent limestone quality to be considered for basic sizing and guarantees. Further the bidder is required to collect limestone samples from site for analysing its characteristic including reactivity. Bidder shall indicate in its bid the quantity of limestone required for such testing.

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Annexure-IV-6

METHANOL CHARACTERISTICS

| SN | Fuel Property | Unit | Methanol |
|----|-----------------------|-------------------|---------------------|
| 1 | Chemical Formula | | CH ₃ -OH |
| 2 | Fuel Carbon | Wt% | 38 |
| 3 | Fuel Oxygen | Wt% | 12 |
| 4 | Density at 20 deg C | kg/m ³ | 792 |
| 5 | LHV | Kcal/kg | 4800 |
| 6 | Boiling Temp | °C at 1 bar | 65 |
| 7 | Vapour Pressure | bar at 20°C | 0.13 |
| 8 | Kinematic viscosity | cSt at 20°C | 0.74 |
| 11 | Auto Ignition | °C | 470 |
| 12 | Heat of Vapourization | kcal/kg | 260 |
| 15 | Flammability limit | vol % | 6-36 |
| 16 | Flash Point | °C | 12 |

PROJECT INFORMATION



Annexure-IV-7(A)

| S.N. | Technical Data | Unit | Specifications for Torrefied Pellet |
|------|---------------------------------|-----------------|---|
| 1. | Base Material | | <p>Agro residue:</p> <p>Which means the leftover portion of the agriculture produce such as stubble/straw/stalk/husk of those agro residue which are surplus and not being used as animal fodder such as paddy, soya, arhar, gwar, cotton, gram, jawar, bajara, moong, mustard, seasam, til, maize, sunflower, jute, coffee etc., groundnut shell, coconut shell, castor seed shell etc., pine needle, elephant grass, sarkanda and horticulture waste such as dry leaves and trimmings generated during the maintenance and pruning of trees and plants.</p> <p>Wood obtained from tree cutting shall not be treated as agro residue and shall be not to be used as base material or mixing purpose whatsoever.</p> |
| 2. | Diameter | mm | <p>In case of cylindrical shape:</p> <p>Diameter: Not more than 35 mm</p> <p>Length: Random</p> <p>For other shapes:</p> <p>No dimension should exceed 35 mm.</p> |
| 3. | Fines % (<3 mm) (ARB*) | Wt% | fines ≤ 5% |
| 4. | Gross Calorific Value (GCVARB*) | Kcal/Kg | Refer below |
| 5. | Moisture (ARB*) | Wt% | ≤ 15% (not more than 15%) |
| 6. | Bulk density | Kg ³ | 600 |

*ARB – As Received Basis

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Annexure-IV-7(B)

The sample was prepared by torrefying rice straw at 300 deg C with a holding time of one hour. Following analysis are carried out at NETRA using the powdered torrefied rice straw samples and the results of various testing for the specific sample is tabulated below:

a. Proximate Analysis (wt %, Air Dried Basis)

| M | Ash | VM | FC |
|------|-------|-------|-------|
| 6.68 | 21.66 | 47.68 | 23.98 |

b. Ultimate Analysis (wt %, Air Dried Basis)

| C | H | N | S | O |
|-------|------|------|------|-------|
| 46.65 | 3.93 | 1.13 | 0.14 | 19.81 |

c. GCV : 4201 kcal/kg

d. Ash Fusion Temperature under reducing conditions: °C

| IDT | ST | HT | FT |
|------|------|------|------|
| 1134 | 1357 | 1374 | 1422 |

e. Ash Elemental Analysis (Elements expressed as Oxides in %w/w)

| Na ₂ O | MgO | Al ₂ O ₃ | SiO ₂ | P ₂ O ₅ | SO ₃ | K ₂ O | CaO | TiO ₂ | MnO | Fe ₂ O ₃ |
|-------------------|-------|--------------------------------|------------------|-------------------------------|-----------------|------------------|------|------------------|------|--------------------------------|
| 2.423 | 7.783 | 4.623 | 67.48 | 1.9 | 1.9 | 6.15 | 4.21 | 0.39 | 0.03 | 2.83 |

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Annexure-IV-7(C)

For the Torrefied Rice Straw Pellets (Prepared by torrefaction of rice straw at 300 deg C with holding time of 1 hr) tested at NETRA, the test results are as follows:

- A. For Anion (ISO 16994:2016 E-Solid Biofuels- Determination of total content of sulphur and chlorine)-reported as wt % dry basis
 - a. Chlorine (Cl): 0.32%
 - b. Fluorine (F) : 0.09%

- B. For Cation (ISO 16967:2015 E-Solid Biofuels- Determination of major elements ...)- Reported as wt % dry basis
 - a. Sodium (Na): 0.31%
 - b. Potassium (K): 2.04%

Note: The above details as at Annexure-IV-7(A), IV-7(B & IV-7(C) are indicative only and shall vary based on the exact raw material and its subsequent processing.