Submitted on 30 MAR 2019.

BEFORE THE TELANGANA STATE ELECTRICITY REGULATORY COMMISSION

HYDERABAD

CASE NO. OF 2019

(To be filled by the office)

IN THE MATTER OF:

Filing of Capital Investment Plan during the control period comprising five years from 1st April 2019 to 31st March 2024 in respect of 2X600 MW Singareni Thermal Power Plant for approval in accordance with Regulation 7(b) of Telangana State Electricity Regulatory Commission (Terms and Conditions of Generation Tariff) regulation 2019.

AND IN THE MATTER OF:

The Singareni Collieries Company Limited (SCCL): Kothagudem Collieries, Bhadradri Kothagudem Dist, Telangana State - 507101; Represented by its authorized representative i.e., **Director Finance, SCCL**.

PETITIONER

AND

1. Southern Power Distribution Company of Telangana Limited (TSSPDCL): Corporate Office: # 6-1-50, Mint Compound, Hyderabad, Telangana-500 063.
2. Northern Power Distribution Company of Telangana Limited (TSNPDCL): H.No: 2-5-31/2, corporate Office, Vidyut Bhavan, Nakkalagutta, Hanamkonda, Warangal, Telangana- 506001

RESPONDENTS

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Through

Shri N. Balram
Director(Finance)
The Singareni Collieries Company Limited
Kothagudem Collieries
Bhadradri Kothagudem Dist,
Telangana State - 507101

(Form II)
(See clause 14 and 15)
General Heading for Proceedings

BEFORE THE TELANGANA STATE ELECTRICITY REGULATORY COMMISSION

HYDERABAD

CASE NO. **OF 20**

(To be filled by the office)

IN THE MATTER OF:

Filing of Capital Investment Plan during the control period comprising five years from 1st April 2019 to 31st March 2024 in respect of 2X600 MW Singareni Thermal Power Plant for approval in accordance with Regulation 7(b) of Telangana State Electricity Regulatory Commission (Terms and Conditions of Generation Tariff) regulation 2019.

AND IN THE MATTER OF:

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PETITIONER

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NOTARY M.KRAVICHANDER RAO GOVT. OF T.S.

29 MAR 2019

RESPONDENTS

Affidavit verifying the Petition

I, Shri N. Balram, son of N. Hunya aged 38 years residing at Bungalow no: S-4, Bungalows area, Lakshmidevipally, Kothagudem – 507101 do solemnly affirm and say that

1. I am the Director Finance of SCCL, the petitioner in the above matter and am duly authorized by the said petitioner to make this affidavit.
2. I have read and understood the contents of the accompanying capital investment plan from 1st April 2019 to 31st March 2024 for 2 X 600 MW Singareni Thermal Power Project located in Jaipur, Mancherial filed in this petition before this Hon'ble Commission for approval .The statements made in paragraphs of the petition accompanying affidavit now shown to me are true to my knowledge and are derived from official records made available to me and are based on information and advice received which I believe to be true and true.

I Solemnly affirm at Hyderabad on 29th day of March, 2019 that the contents of the above affidavit are true to my knowledge, no part of it is false and nothing material has been concealed there from.

(Shri N. Balram)

Place : Hyderabad
Date : 29.03.2019

ATTESTED

ATTESTED
NOTARY
M. RAMCHANDER RAO
ADVOCATE
H. No. 22-2-849/3, Noor Khan Bazar,
HYD-24. T.S. India. Goms No. 457/11.
29 MAR 2019

(Form I)
(See clause 13 and 14)
General Heading for Proceedings
BEFORE THE TELANGANA STATE ELECTRICITY REGULATORY COMMISSION

HYDERABAD

CASE NO. OF 2019

(To be filled by the office)

IN THE MATTER OF:

Filing of Capital Investment Plan during the control period comprising five years from 1st April 2019 to 31st March 2024 in respect of 2X600 MW Singareni Thermal Power Plant for approval in accordance with Regulation 7(b) of Telangana State Electricity Regulatory Commission (Terms and Conditions of Generation Tariff) regulation 2019.

AND IN THE MATTER OF:

The Singareni Collieries Company Limited (SCCL): Kothagudem Collieries, Bhadradri Kothagudem Dist, Telangana State - 507101; Represented by its authorized representative i.e., **Director Finance, SCCL**.

PETITIONER

AND

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RESPONDENTS

3. **Facts of the Case:** This petition is filed for approval of Capital Investment Plan during the control period comprising five years from 1st April 2019 to 31st March 2024 in respect of 2X600 MW Singareni Thermal Power Plant in accordance with Regulation 7(b) of Telangana State Electricity Regulatory Commission (Terms and Conditions of Generation Tariff) regulation 2019.

The details of Petitioner are respectfully submitted as under:

I. Name and Address of Applicant: **The Singareni Collieries Company Limited (SCCL), Kothagudem Collieries, Bhadradri Kothagudem Dist, Telangana State -507101**

II. Primary Business of the Applicant: **Coal Mining**

III. Details of Distribution Licensee purchasing power:

a. **Southern Power Distribution Company of Telangana Limited (TSSPDCL): Corporate Office: # 6-1-50, Mint Compound, Hyderabad,Telangana- 500063.**

b. **Northern Power Distribution Company of Telangana Limited (TSNPDCL): H.No: 2-5-31/2, Corporate Office, Vidyut Bhavan, Nakkalgutta, Hanamkonda, Warangal, Telangana- 506001.**

IV. Details of Generating Company: **The Singareni Collieries Company Limited(SCCL): Kothagudem Collieries, Bhadradri Kothagudem Dist, Telangana State -507101.**

V. Name and Location of the Generating station for which Aggregate Revenue Requirement and tariff to be determined, is as follows:

a. Name/Location of Generating Station: **Singareni Thermal Power Project (STPP), Pegadapalli (V), Jaipur Mandal, Mancherial District, Telangana**

b. Total existing unit wise installed capacity in MW: **Unit-I: 600 MW, Unit-II: 600 MW**

c. Nature of Generation plant: **Thermal**

d. Type of primary and secondary fuel:

i. Primary Fuel: **Coal**

ii. Secondary Fuel: **Light Diesel Oil/Heavy Fuel Oil**

e. Commercial operation of units:

i. Unit-I: **25.09.2016**

ii. Unit-II: **02.12.2016**

4. **Grounds of the case:** This filing for capital investment plan is in accordance with the provisions of the Section 62.1 and 86.1 (a) of Electricity Act 2003 read with regulation 7 of Telangana State Electricity Regulatory Commission (Terms and Conditions of Generation Tariff) regulation 2019.

While filing the present Capital investment plan, The Singareni Collieries Company Limited has endeavored to comply with the various applicable legal and regulatory directions of this Hon'ble Commission including the directions contained in the Conduct of Business regulation 2015 and the Regulations 1of 2019 (Terms and Conditions of generation Tariff regulation 2019) issued by Hon'ble TSERC.

Based on the information available, the applicant has made bona-fide efforts to comply with the directions of the Hon'ble Commission and discharge its obligations to the best of its abilities. However, should any further material become available in the near future, the Applicant reserves the right to file such additional information and consequently amend/revise the application.

5. **Summary of Capital Investment Plan**

A summary of capital investment plan is placed below:

Singareni Collieries Company Limited (SCCL) is a coal mining company owned by the Government of Telangana with 51% shareholding. Government of India owns remaining 49% shares of the company. SCCL established Coal based Singareni Thermal Power Plant (STPP) with two units of 600 MW in Jaipur Mandal, Mancherial District of Telangana. The units of STPP achieved COD during financial year 2016-17. STPP supplies power to state Discoms of Telangana and the tariff of such sale of power is to be determined by Hon'ble TSERC as per 86.1(a) of electricity Act 2003.

Hon'ble TSERC has notified terms and condition of generation tariff regulation 2019 (Regulation no 1 of 2019) for determination of multi-year tariff for the period 2019-24. Regulation 7(b) of aforesaid tariff regulation stipulates the generator to submit capital investment plan for 2019-24 at the beginning of the control period for the existing capacity.

The capital investment plan (CIP) for STPP is prepared primarily based on capital expenditure towards compliance of new pollution norms for which DPR was prepared by M/s NTPC limited and capital expenditure for procurement of critical modules for which proposal is obtained from original equipment manufacturer (OEM). The other part of CIP is proposed for

works required for railway siding and for civil work in main plant area and township area.

Proposed expenditure of CIP is given in the table below:

SUMMARY OF CAPITAL INVESTMENT PLAN FOR FY 2019-24 (BASED ON PUT TO USE)							
							(IN Crores)
SL NO	DESCRIPTION	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24	Total
1	FLUE GAS DE-SULPHURISATION SYSTEM (FGD)	0	0	645.32	0	0	645.32
2	IN-FURNACE MODIFICATIONS FOR NOX MITIGATION	0	19	19	0	0	38
3	OPERATION & MAINTENANCE MODULES	153.10	82.95	65.12	0	0	301.18
4	RAILWAY WORKS	26.94	24.50	79.60	0	0	131.03
5	MAIN PLANT CIVIL WORKS	26.91	20.98	8.00	0	0	55.89
6	TOWNSHIP CIVIL WORKS	7.81	10.20	6.14	0	0	24.15
	Total	**214.75**	**157.63**	**823.18**	**0**	**0**	**1195.57**

Further, as it is difficult to project the capital expenditure for 2019-24 as per Ind AS 16, STPP has sought permission from the Hon'ble commission to submit these expenditures during Mid-term review and End of control period review for consideration of the commission.

The detail Capital investment Plan is enclosed in **Annexure I.**

6. **Authorization for filing on the petition:** The Director (Finance) of SCCL has been authorized to sign on the petition / documents to be filed before the Hon'ble TSERC. Copy of the authorization is enclosed as **Annexure II.**

7. **Jurisdiction:** This Capital investment Plan is related to tariff determination and is within the Jurisdiction of TSERC. As per section 62, Appropriate commission can determine the tariff for supply of electricity by a generating company to a distribution licensee. Further, the state electricity regulatory commission shall determine the tariff for generation within the state as per section 86.1(a) .

8. **Limitation:** The determination of tariff is a continuous process and the provisions of limitation Act does not apply to the issues to be decided as part of regulatory process such as approval of capital investment plan etc.

9. **Court Fee:** The present petition is filed as normal petition accompanying the Multi Year tariff petition for 2019-24. Hence a fees of Rs 10,000/- is paid as per regulation 4 (c) of regulation 2of 2016 (levy of fees for various services rendered by the commission). A copy of the banker's cheque is attached as **Annexure -III**.

10. **Declaration:** This subject matter of this petition has not been raised by the petitioner before any other competent forum and that no other competent forum is currently seized of the matter or has passed any order in relation thereto.

11. **Prayer before Hon'ble commission**

SCCL prays to the Hon'ble Commission that it may be pleased to:

a) Consider the submissions made by SCCL and allow the capital investment plan for Financial year 2019-24 in respect of 2x 600 MW Singareni Thermal Power Plant;
b) Pass such further Orders, as the Hon'ble Commission may deem fit and appropriate considering the circumstances of the case.

(Shri N. Balram)

Place : Hyderabad
Date :29.03.2019

(8)

Filing of

Capital Investment Plan 2019-2024

For

Singareni Thermal Power Project (2 X 600 MW) in Jaipur, Mancherial District.

To

Telangana State Electricity Regulatory Commission (TSERC)

By

The Singareni Collieries Company Limited

INDEX

1 Executive summary

Singareni Collieries Company Limited (SCCL) is a coal mining company owned by the Government of Telangana with 51% shareholding. Government of India owns remaining 49% shares of the company. SCCL established Coal based Singareni Thermal Power Plant (STPP) with two units of 600 MW in Jaipur Mandal, Mancherial District of Telangana. The units of STPP achieved COD during financial year 2016-17. STPP supplies power to state Discoms of Telangana and the tariff of such sale of power is to be determined by Hon'ble TSERC as per 86.1(a) of electricity Act 2003.

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The capital investment plan (CIP) for STPP is prepared primarily based on capital expenditure towards compliance of new pollution norms for which DPR was prepared by M/s NTPC limited and capital expenditure for procurement of critical modules for which proposal is obtained from original equipment manufacturer (OEM). The other part of CIP is proposed for works required for railway siding and for civil work in main plant area and township area.

Proposed expenditure of CIP is given in the table below:

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4	RAILWAY WORKS	26.94	24.50	79.60	0	0	131.03

5	ERECTION WORKS IN MAIN PLANT	26.91	20.98	8.00	0	0	55.89
6	TOWNSHIP CIVIL WORKS	7.81	10.20	6.14	0	0	24.15
	Total	214.75	157.63	823.18	0	0	1195.57

Further, as it is difficult to project the capital expenditure for 2019-24 as per Ind AS 16, STPP has sought permission from the Hon'ble commission to submit these expenditures during Mid-term review and End of control period review for consideration of the commission.

The projected expenditure from 01.10.2018 to 31.03.2019 was 360.62 Crore. However, some of these expenditures will be spilled over to next control period.

2 Introduction :

2.1 Background:

Singareni Collieries Company Limited (SCCL) is a coal mining company incorporated under the companies Act 1956. The company is owned by the Government of Telangana with 51 % Shareholding. The shareholding of Government of India in SCCL is 49%.

SCCL has entered into the business of power generation by setting up a 2X600 MW Coal based Thermal Power Plant, namely Singareni Thermal Power Plant (STPP) in Jaipur of Mancherial District. The units of STPP achieved COD during financial year 2016-17 in the dates as mentioned below.

COD Unit-I : 25.09.2016

COD Unit-II : 02.12.2016

SCCL had entered into a Power Purchase Agreement (PPA) with two Distribution companies of Telangana for supplying the total power generated from STPP at a tariff decided by hon'ble Telangana State Electricity Regulatory Commission (TSERC). The PPA shall remain valid for a period of 25 years from the COD of the last unit (unit-II).

2.2 Enabling Regulation

It is to state that as per section 62, the appropriate commission can determine the tariff for supply of electricity by a generating company to a distribution licensee. The state electricity regulatory commission shall determine the generation tariff within the state in accordance with section 86.1(a) of electricity act.

Hon'ble TSERC has notified terms & conditions of generation tariff 2019 for determination of tariff with respect to generators selling within the state. This regulation shall be applicable for the control period consisting five years from April 1st 2019 to March 31st 2024.

Regulation 7(b) of aforesaid tariff regulation provides for submission of capital investment plan by the generators which is to be filed at the beginning of the control period.

Regulation 7.4 provides that the capital investment plan during 2019-24 is required to be commensurate with existing capacity. Accordingly, STPP has prepared capital investment plan during the control period commensurate with the requirement of existing generating capacity of 2X600 MW.

It is to state that the proposal of constructing STPP Phase II (1 x 800 MW) is under active consideration by the SCCL management. However, the necessary permissions have not been obtained till date. The Hon'ble commission is requested to allow SCCL to submit capital investment plan for STPP phase II after receiving all necessary approval.

2.3 Capital expenditure up to cutoff period:

The capital cost of the STPP (2 x 600 MW) project as per revised cost estimate was 8584 crore which is the net of capital expenditure amounting 8780 crore and a claim of grant from CCDAC amounting 196 crores. The project has expended 8461.94 crore upto 30.09.2018 as per audited statement of capital expenditure. The balance expenditure is expected to be made by 31st March 2019 except some spill over items.

3 Approach to Capital Investment Plan:

It is stated that the capital investment Plan is prepared by considering schemes of high importance. Some of the schemes are necessitated to comply new environment protection rules. Scheme to purchase critical modules is found to be important considering the high PLF commitment in the coming control period and the cases of failures reported in similar machines.

Railway electrification by constructing overhead lines and by commissioning signalling and telecommunication system shall be made to ensure safe running of railway siding. The facilities such as market complex, sports complex or club building are a regular feature in other thermal power plants. These infrastructures are required for modest living in the township and are required to be constructed by the company. Expenditures for construction of watch towers along the boundary wall are required from security point of view. The requirement of works in main plant area and township were reviewed. It is also found that several work in these areas also need to be taken up during 2019-24.

The accounting of Property, Plant and equipment is required to be made as per new accounting standard Ind AS 16. The segregation of capital item as per Ind AS 16 is a complicated process. Accordingly, the non-scheme capital expenditures as per AS 16 will be known at the end of years and a projection of these expenditures cannot be made now.

4 Capital investment for Environmental compliance:

4.1 Background

It is to submit that Ministry of Environment, Forest and Climate Change (MOEF &CC) has issued notification no: S.O.3305(E) titled 'Environmental (Protection) Amendment rules, 2015 dated 7.12.2015. The said notification has brought out amendments to Schedule - I of Environment (Protection) Rules, 1986 for emission norms applicable to thermal power stations.

Both the units of STPP have been commissioned in calendar year 2016. Accordingly, following emission norms which are applicable to the thermal power plant TPPs (Units) installed between 1st January 2004 and 1st January 2017 as per the amendment notification will also be applicable to STPP units.

POLLUTANTS	BEFORE AMENDMENT	AFTER AMENDMENT
Particulate Matter (PM)	100 mg/Nm3	50 mg/Nm3
Sulphur Dioxide (SO2)	600 mg/Nm3	200 mg/Nm3
Oxides of Nitrogen	NOT SPECIFIED	300 mg/Nm3

Mercury (Hg)	0.03 mg/Nm3	0.03 mg/Nm3

Currently STPP, SCCL is in compliance with the normative emission limit with respect to particulate matter and mercury. It is to state that STPP, SCCL has awarded the work of preparing feasibility report and Detailed project Report (DPR) to M/s NTPC for complying SO_2 emission norms and working closely with original equipment manufacturer (OEM) towards In-furnace modifications for NOx mitigation.

The emission limits as per amended notification are to be met within two years from date of the amendment notification.

However, in view of technical Challenges in implementing new technologies like FGD, revised dates for compliance of new emission standards was submitted by Ministry of Power vide its letter dated 13.10.2017.

As per the timeline provided in the revised plan, the FGD system for Units 1 and 2 (2X600 MW) of SCCL was required to be put into operation within the Dec'2019.

It is stated that STPP sought extension of time from Dec'2019 to Dec'2022 for complying SO_2 emission limit considering the time required for floating tender, awarding work, erecting and commissioning of FGD system by its letter dated 23.01.2019. The letter is attached as **Appendix A.**

It is stated that M/s NTPC Ltd submitted DPR for FGD system which is attached as **Appendix B.**

4.2 Capital investment for SOx compliance:

A summary of the DPR for FGD system as prepared by M/s NTPC Ltd is presented below:

4.2.1 Preamble:

SO_2 emission from fossil fuel fired power plants is proportional to Sulphur content of fuel. Power plants in India traditionally use a very low/medium grade coal with low/medium Sulphur content. The sulphur content in the coal supplied to STPP is in the range of 0.65%-1.15% as revealed by ultimate analysis of coal made on as received basis (100% BMCR Condition).

The SO_2 emissions from STPP, SCCL (2X600 MW) is estimated to be around 2000-3500 mg/Nm^3 considering the reported range of sulphur content in the coal supplied to STPP in absence of desulphurization system.

The estimated SO_2 emission from STPP is approximately 9-15 times the SO_2 emissions permitted by the new environment norms. It is therefore, required to install desulphurization

system capable to reduce SO_2 by 95% which shall result in a net emission level lesser than given limit of 200 mg/Nm3.

4.2.2 Different Desulphurization Processes

Nearly all flue gas desulphurization processes depend on the fact that SO_2 is acidic in nature and use an alkaline substance, most commonly lime or lime stone to neutralize it. Other alkalis like sodium based, magnesium-based alkalis and other type of alkalis such as Ammonia etc. are also used. FGD processes are classified into three different types:

i) Semi dry / dry process

ii) Wet FGD process

iii) Dry Sorbent Injection System

4.2.3 Comparison of different technologies of desulphurisation process:

The following table depicts the comparison made for available desuperization processes across different technological and commercial parameters.

Item	Spray Dry Process	Process CFB / CDS Dry	Wet Limestone	Ammonia process	Dry Sorbent Injection (DSI)
Sorbent	Lime	Lime	Limestone	Ammonia	Sodium bicarbonate
Coal Sulphur Limit	For low and medium Sulphur content coal	No limit	No Sulphur content limit	No Sulphur content limit	For low and medium Sulphur content coal
Removal efficiency	90-95%	Above 95%	Above 95%	Above 95%	<85%
Sorbent source	Hard to obtain	Hard to obtain	Local	Depends on availability	Depends on availability
Sorbent Utilization	Poor	Poor	Good	Good	Poor
Aux. Power	Low	Low	High	Very High	Low
Capital Cost	Low	Low	High	High	Low

Operating Cost	High	High	Low	Low	Very High
Reference Plants above 500 MW	Few	Few	Many	Few	Few

4.2.4 The reasons for opting Wet limestone process:

The Wet Limestone process is selected for SCCL (2X600 MW) Stage-I for the following reasons:

i. Ability to achieve high desulphurization efficiency (removal efficiency is above 95%)
ii. High Dust removal as a co-benefit.
iii. High reagent utilization factor (sorbent utilisation is good)
iv. Reagent material (limestone) used by the process is plentiful and readily available.
v. Large number of reference plants.
vi. Maturity of technology involving minimum commercial risks and large number of suppliers resulting in enhanced competition.

4.2.5 Lime stone requirement for STPP

The daily requirement of limestone for plant shall be approximately 650 ton at100% plant load factor. The lime stone requirement is indicated in table below for 100 %, 90 %, 80 % and 70 % plant load factor.

PLF	100%	90%	80%	70%
Lime stone requirement in Ton/Day	650	585	520	455

4.2.6 Additional auxiliary consumption for FGD

The uninterrupted electrical power requirement shall be met through three voltage levels i.e. 11 kV, 3.3kV & 0.415 kV which are already adopted in the existing system of Stage-I for feeding power to the plant auxiliaries.

The total connected load expected for proposed FGD system will be around 15.0 -18.0 MW for 600 MW unit. However, the running loads will be around 9.0 MW for 600 MW unit. The auxiliary power consumption for introduction of FGD would contribute to increase in plant auxiliary consumption by 1.5%.

4.2.7 Cost Estimate For Installation Of Flue Gas Desulfurization (FGD) System

The estimated head wise cost for FGD system is given in the table below:

Serial No	Cost Head	Value in Lakhs
1	Supply	30556.63
2	Spares	1527.83
3	Type Test charges	8.63
4	Freight & Insurance	1283.38
5	Civil	9136.34
6	Structural	540.92
7	Erection & commissioning	6111.33
8	Training	10.00
9	System Integration	23.39
	Subtotal	49198.45
10	GST	8855.72
11	Work cost including GST	58054.17
12	Contingency @3%	1741.63
13	IDC Including FC	4736.95
	Grand total	64532.75

The quarter wise phasing of the expenditure from 2019-20 to 2021-22 for FGD system is given in Clause no 4.00.00 of Chapter No -13 of financial analysis of detailed project report (DPR) for FGD system which is attached as **Appendix B.**

4.2.8 Summary of proposal for FGD:

- The Wet Limestone process is selected for SCCL (2X600 MW) for flue gas desulphurization.
- Estimated cost for installation of FGD in Singareni TPP (2 X 600 MW) will be 645.33 Crores (including IDC)
- Time for completion: 27 MONTHS (after placement of order).
- Expected FY for commissioning of FGD: 2021-22.
- The interest rate considered for IDC calculation is 9.46%
- Increase in plant auxiliary consumption: 1.5%
- Lime stone consumption: Approximate 650 ton at 100% plant load factor depending on sulphur content of coal.
- The estimated impact of the FGD installation in the fixed charge is 12 Paise/Kwh .
- The estimated impact of the FGD installation in the variable charge is 4 Paise/Kwh .

4.3 Capital investment for NOx compliance:

4.3.1 Preamble:

STPP units (2X600 MW) of SCCL was commissioned in the year 2016 . The Boilers of the units were originally designed for NOx level of 750 mg/Nm^3. The measured value of NOx is found to be almost near to the designed value. However, as per the Gazette notification dated 15.12.2015 the NOx level has to be reduced to 300 mg/Nm3.

NOx mitigation can be approached in three different ways for this plant.

- In-furnace modifications like providing OFA, BOFA and Horizontal offset air system depending on the boiler capacity
- SNCR (Selective Non Catalytic Reduction)
- SCR (Selective Catalytic Reduction)

In furnace modifications do not require chemical treatment by reagents and therefore is a cost-effective measure compared to other methods. Moreover, original equipment manufacturer (OEM) also specified this methodology for reduction of NOx level. Accordingly, Combustion Modification is to be undertaken in both units of STPP to reduce the NOx to the desired level.

In-furnace modification produces staged combustion by diverting a portion of the secondary air above the firing zone, which in turn reduces the amount of available oxygen in the main combustion zone, where NOx is mostly generated.

It is stated that combustion modification is to be carried out as a part of furnace modification, which would be required to reduce the NOx generation in combustion chamber. Combustion modification consists of replacing/modification the existing wind box by new redesigned wind box and installation of separator over fire air panel along with dampers.

The objective of combustion modification is to reduce the NOx generated to the required level during the combustion in boiler without effecting the designed boiler steam and flue gas parameters at various loads, under various mills combination for the range of coals.

The letter from OEM detailing the cost of the NOx mitigation proposal is attached in **Appendix C**

4.3.2 Summary of proposal for NOx mitigation:

- M/s BHEL has provided the estimated cost for NOx reduction system.
- Estimated cost for installation of low NOx system would be approximately 38.00 Crores.

- Time for completion (after placement of order): 09 MONTHS considering engineering, supply and erection. However, the work recuires Unit shutdown for final attachments with the boiler which shall be planned as per the Annual Overhaul schedule of units.
- Expected FY for commissioning of low NOx system: U 1 :2020-21, U 2 : FY 2021-22

SUMMARY OF CAPITAL INVESTMENT PLAN FOR NOx MITIGATION SYSTEM						
(IN Crores)						
DESCRIPTION	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24	Total
IN-FURNACE MODIFICATIONS FOR NOX MITIGATION	0	19	19	0	0	38

5 Capital investment in Critical Module

5.1 Justification

It is to state that the projected PLF during 2019-24 is around 91% as detailed in the generation planning part of the business plan. It is utmost important to keep necessary capital spares available during the coming control period for successful execution of generation plan. It is submitted that HP module, IP module, LP rotor, Generator stator, rotor and exciter are the major constituents of turbine generator assembly used for generation of electricity.

It is observed from the past experiences that when any of this equipment fails for whatever reason and order is placed for replacement of Original Equipment Manufacturer (OEM), the manufacturer requires a high lead time of around one year to supply a new one or at least four months time for refurbishment.

The high lead time is attributable to the fact that OEM imports the input materials necessary for these modules from other countries and arrange required machining and assembling activity here. Therefore, any failures of any of these equipment are costly and needs special attention while formulating capital investment plan.

As per the power purchase agreement entered between SCCL and TSDiscoms, STPP is expected to meet the availability norms set by the regulator and full fixed charges can be claimed only after achieving the normative availability. Therefore shut down of units in the range of four months to one year will impact the cash flow of both SCCL and TSDISCOMs.

SCCL will lose due to non-recovery of full fixed charges while TSDiscoms will also loss from the arrangement of alternative power supply from the market. It is submitted that the short-term power markets are highly volatile and unpredictable. Therefore, a win-win situation may be achieved if STPP is allowed to make capital expenditures to procure the critical modules.

STPP has two similar units of 600 MW supplied by BHEL. Accordingly, it is planned to purchase one set of HP module, IP module, LP rotor, generator stator, rotor and excited assembly which would cater the need of both the units effectively.

It is submitted that major break down have been experienced recently in 600 MW BHEL sets for the following stations:

- TSGENCO faced generator rotor failure on 14.12.2018
- Similar incidents were witnessed in TNSEB, North Chennai where outage duration extended up to 6 months.
- Jindal India Thermal Power Limited in Odisha has experienced similar failure in generator.
- Unit of MS Avanta Power had witnessed generator failure which forced it to be in outage condition for 6 months.

STPP has obtained budgetary offer for the critical modules from the original equipment manufacturer i.e., BHEL. The same is enclosed in **Appendix D**.

It may please be noted from the failure history cited above that the generator stator and rotor are the most vulnerable modules and required to be purchased in the beginning years of the control period. It is also submitted that unit-I of STPP witnessed cracks in couple of LP turbine blades. Accordingly, LP turbine is required to be recognised as high problem area and LP rotor is also planned to be purchased in the initial years of coming control period. The purchase of HP module, IP module and exciter assembly is planned during 2020-2022 to distribute capital investment judiciously so that the impact of these expenditures on tariff gets minimised.

The year wise add cap proposal for purchasing the critical modules are given below:

(In INR Crores)

Critical modules	Financial Year	Total

	2019-20	2020-21	2021-22	
HP module	0.00	46.51	0.00	46.51
IP module	0.00	0.00	53.82	53.82
LP rotor	25.20	0.00	0.00	25.20
Generator stator	63.00	0.00	0.00	63.00
Generator rotor	38.33	0.00	0.00	38.33
Exciter assembly	0.00	22.05	0.00	22.05
Total	126.53	68.56	53.82	248.91

The above cost are quoted by OEM Ex works basis and the associated taxes , duties and transportation cost needs to be incurred to bring the above items in the plant.

Therefore, it is required to add freight and GST to arrive at final cost. The final cost of the module is computed with a freight @ 3% and IGST @ 18% of ex work quoted price.

It is to further state that the capital expenditure approved on account of initial spare as per the Hon'ble TSERC order dated 17.06.2017 was 168.40 Crore. This amount was less than the ceiling of 4% of cost of Plant and Machinery. It is to submit that Hon'ble TSERC has adopted CERC regulation 2014 for determination of tariff for STPP. As per Regulation 13 of the CERC (Terms and Conditions of Tariff) Regulations, 2014, ceiling norm of initial spares is 4.0% of the cost of Plant and Machinery. The commission has observed the following in respect of initial spare in STPP's tariff order dated 19.06.2017:

"3.17 INITIAL SPARES

Commission's Analysis and Ruling

3.17.1 Regulation 13 of the CERC (Terms and Conditions of Tariff) Regulations, 2014 specifies the ceiling norm of initial spares as 4.0% of the cost of Plant and Machinery. In reply to a specific query of the Commission, SCCL submitted the total amount of spares included in the capital cost as Rs. 168.40 Crore. The Commission observes that the spares of Rs. 168.40 Crore amounts to 2.50% of the GFA of Rs. 6730.42 Crore under the asset class Plant & Machinery. Hence, the total spares are well within the ceiling limit"

It is also to submit before the Hon'ble commission that the TSERC generation tariff regulation 2019 also provides the following norm in respect of initial spare:

" 7.17. The capital cost may include initial spares capitalised as a percentage of the plant and machinery cost up to the Cut-Off Date, subject to the following ceiling norms: -

Coal based Generating Stations: 4%

Accordingly, the hon'ble commission is requested to allow the expenditures for proposed modules .These modules will definitely improve the plant availability not only for the coming control period but for the entire life of the plant.

5.2 Detailed Proposal for capital modules

Final summary of price estimation of the critical modules along with the schedule of capitalisation is given below:

(In INR Crores)

Critical modules	Financial Year			Total
	2019-20	2020-21	2021-22	
HP module	0.00	56.28	0.00	56.28
IP module	0.00	0.00	65.12	65.12
LP rotor	30.49	0.00	0.00	30.49
Generator stator	76.23	0.00	0.00	76.23
Generator rotor	46.38	0.00	0.00	46.38
Exciter assembly	0.00	26.68	0.00	26.68
Total	153.10	82.96	65.12	301.18

6 Capital Investment in Railway Works:

6.1 Justification

It is to submit that the railway siding work was commissioned during the financial Year 2018-19. Most of the coal required for power generation is now received at the project site through railway mode. At present, the railway locos are running with diesel engines and manually managed signalling system. Railway authorities have advised to arrange for overhead electrification system along with necessary signalling and telecommunication works to ensure safe running of railway wagons. It is to submit that the railway electrification will be

taken up as per the cabinet decision of Govt of India. The relevant letter dated 27.09.2018 is enclosed as **appendix E**

It is to kindly state that The S&T (Signalling & Telecommunication) work is required due to following reasons:

1. STPP siding consists three numbers yards (SRP-CHP, SRP-OCP and STPP).
2. Single track-line is only provided for movement in-between the yards.
3. Loading arrangements are being planned at two locations i.e., SRP-CHP and SRP-OCP.
4. For 2x600 MW: –
   - 6 coal load rakes and 6 empty rakes move on the track-line on daily basis.
   - Fuel oil rake is expected once in a fortnight.
   - Fly-ash evacuation is also planned from STPP through rakes.
5. After addition of 1x800 MW, the traffic increases further.
6. Railways have deployed rakes for transport of coal and are operating movement of rolling stock. Railways designated track speed as 50 KMPH.
7. Operation of so many rakes in a short distance requires higher efficiency and to ensure safety , S&T is recommended to avoid human error.
8. S&T enables optimum utilisation of the track structure with minimum man-power and interference.
9. Railways further opined that as main line is provided with S&T, provision of S&T in STPP yard will enable smooth operation of rolling stock avoiding accidents and ensures safety.
10. Due to implementation of this lot of man-hour and expenditure will be saved.

M/s Rites Ltd was the consultant for railway siding work for STPP. M/s Rites prepared detailed report for overhead electrification and telecommunication work providing the detail scope and cost estimation. It is expected to finish electrification and signalling work by the financial year 2021-22.

It is to state that some of the associated works related to construction of railway siding system such as construction of drainage system along the railway track is also planned in the coming control period as per the original drawing.

It is stated that post commercial operation, some incidents of wagons derailment was observed during operation of railway system. It is also planned to get special tools and capital spares related to railway system to mitigate such emergency situation.

Accordingly, a comprehensive capitalization plan for railway siding is prepared for the approval of the Hon'ble commission.

6.2 detailed proposal

The detailed proposal for railway works is placed below:

Capital Investment Plan for railway works in 2019-2024 (Amounts in Lakhs)						
Sl.No.	Name of Investment	Year in which proposed to put to use			Total (2019-22)	Justification
		2019-20	2020-21	2021-22		
1	Casting & fixing of boundary pillars along the railway tracks	17.11	-	-	17.11	To prevent encroachment in acquired land of railway track area.
2	Three numbers 120T in motion weigh bridges and associated civil works	91.40	-	-	91.40	These are required for weighing coal, fly ash & oil carried by rail wagons.

3	Overhead Electrification (OHE) works	200.00	200.00	4,100.00	4,500.00	The scope of this work was included in detailed project report (DPR). The delay in awarding the contract is due to land acquisition issues.
4	Signalling & Telecommunication (S&T) works including civil works	450.00	450.00	3,860.00	4760.00	The scope of this work was included in detailed project report (DPR). The delay in awarding the contract is due to land acquisition issues.
5	Re-organisation of village roads along the track-line, construction of walk-ways & foot bridges, misc. and unforeseen	350.00	150.00	-	500.00	Some village roads got blocked by construction of plant railway line. So re-organisation of village roads are required for public convenience.
6	Drains along railway track	1000.00	650.00	-	1,650.00	The proposed drains are required to be constructed as per approved design of railway track.
7	Rerailing tools	85.00	-	-	85.00	These tools are required for re-railing of derailed railway wagons/engine.
8	Inspection road along track line	500.00	500.00	-	1000.00	

9	Capital spares for railway track: Sleepers and rails	-	500.00	-	500.00	These spares are required to replace damaged sleepers and rails as a result of unforeseen derailment.
	subtotal main railway	2,693.51	2,450.00	7,960.00	13,103.51	

7 Capital Investment In erection work in Main Plant:

7.1 Justification:

The requirement of capital works especially of the nature of erection /civil work inside the main plant area is reviewed. It is found that several expenditures such as construction of watch towers along the boundary wall and parking shed near CISF office are required from security point of view.

It is to submit that some of the mandatory works as per the factories act 1948 such as provision for creche and rest hall and construction of pit for hazardous waste shall be taken up in the upcoming control period.

It is also observed that the movement of trucks carrying bottom ash near weigh bridge area was not smooth due to the lack of parking yard for trucks. Accordingly, a parking lot for trucks is proposed near main gate area. This is also expected to reduce occurrence of accidents near main gate area.

It is to state that the plant soil is of black cotton type which lacks adequate strength to support movement of heavy vehicles specially during rainy season. It is planned to construct RCC flooring near High concentrated slurry disposal system (HCSD) area, stacker reclaimer area and IDCT area where movement of heavy vehicles were observed during past years of operation.

It is stated that the drainage and sewage system of main plant area was also reviewed. It is found that some of the necessary works like connecting outer point of BOP & BTG drains up to peripheral compound wall, connecting plant sewage pits to sewage treatment plant ,constructing RCC drain across fly ash road are to be taken up in the control period 2019-24.

Some additional roads and bridges are also required to be constructed to facilitate inspection to important plant facilities such as reservoir, Ash dyke and to provide for temporary approaches for plantation activities.

Accordingly, a comprehensive capitalization plan for main plant civil work is prepared for the approval of the Hon'ble commission.

7.2 detailed proposal

The detail proposal for erection work in main plant is placed below:

Capital Investment Plan for erection works in main plant during 2019-2024 (Amounts in Lakhs)						
Sl.No.	Name of Investment	Year in which proposed to put to use			Total (2019-22)	Justification
		2019-20	2020-21	2021-22		
1	Watch towers and road along boundary wall	160.00	-	-	160.00	CISF is deployed to ensure plant security. The proposed expenditure is as per their recommendation to make proper arrangement for security.
2	Parking shed at CISF time office	95.00	-	-	95.00	CISF is deployed to ensure plant security. The proposed expenditure is as per their recommendation to make proper arrangement for security.

3	Construction of creche and rest hall	50.00	50.00	-	100.00	The facility is required to be provided as per Factories Act 1948.
4	Construction of shed for lube oil barrels, RCC pit for hazardous waste	50.00	50.00	-	100.00	The facility is required to be provided as per Factories Act 1948.
5	Ash trucks parking yards at ash weighbridge near main gate	50.00	50.00	-	100.00	This work is required to be taken up to avoid stuck up of trucks at plant gate during entering or exiting plant premise.
6	CC flooring around HCSD silo area	115.00	-	-	115.00	The plant soil is of black cotton type which are clayey in nature. The vehicle movements during monsoon season over this black soil is very difficult due to its sticky nature. Accordingly, CC flooring around HCSD silo area is required to maintain smooth movement of vehicles even in rainy season.
7	Widening of CC platforms and roads around IDCT	400.00	186.00	-	586.00	The plant soil is of black cotton type which are clayey in nature. The vehicle movements during monsoon season over this black soil is very difficult due

						to its sticky nature. Accordingly, widening of CC platforms and roads around IDCT area is required to maintain smooth movement of vehicles even in rainy season.
8	CC Roads around Stacker Reclaimer	300.00	400.00	300.00	1,000.00	The plant soil is of black cotton type which are clayey in nature. The vehicle movements during monsoon season over this black soil is very difficult due to its sticky nature. Accordingly, roads around stacker reclaimer is required to maintain smooth movement of vehicles even in rainy season.
9	Paving with chequered tiles under pipe & cable rack areas and below coal gantries	500.00	500.00	500.00	1,500.00	Required to prevent vegetation growth and to ensure ease in equipment access. Also prevents fire hazards.

10	RCC drain along fly ash transport road	-	162.00	-	162.00	The RCC drain will prevent stagnation of storm water inside the compound wall of STPP.
11	Extension of BOP & BTG drains up to peripheral compound wall	-	300.00	-	300.00	Kucha drains are existing from the outfall point of BTG & BOP drains up to the drains at outer periphery of compound wall. These kucha drains were conducive for vegetation growth and resultant earth collapse. To prohibit such occurrence, the BTG & BOP drain outfalls need to be connected to the drains at peripheral compound wall.
12	Chambers and dewatering pumps in main plant area	60.00	60.00	-	120.00	To avoid water stagnation inside the main plant area specially during rainy season.
13	Sewage pits (pumps) / pipe line from BTG area to STP	60.00	40.00	-	100.00	Required to connect the sewage system of BTG to sewage treatment plant.

14	Metal road on reservoir bund	63.00	-	-	63.00	This is required for inspection of reservoir bund especially during rainy season.
15	B.T. over inspection road along periphery compound wall from Ash dyke to Rly bridge across Rasulpalli vagu (3.60 KM) and B.T. road over reservoir	150.00	150.00	-	300.00	Required for inspection of along peripheral compound wall and reservoir.
16	Making approaches to plantation at various locations	100.00	50.00	-	150.00	The approach road is required for inspecting as well as attending plantation activity spread across entire plant area.
17	Bridge over diverted nala near CISF time office	248.00	-	-	248.00	The diversion of nala was done to avoid the over flowing of water from nala to enter into main plant area. The construction of bridge over nala was taken up to provide necessary road access.
18	Work stations , furniture's and portico in Administration building and service building.	290.00	100.00	-	390.00	The managers & staff of the plant who oversee the power generating activity sit in the administrative building & service building. The required

						expenditure is to construct work stations to achieve full functionality of admin & service building.
	Sub total plant works	2,691.00	2,098.00	800.00	5,589.00	

8 Capital Investment in Township Civil Works

8.1 Justification

The STPP township was put to use in the last control period. The more people occupied the township, the more the problem of staying inside the township surfaced. It is found that the residents of STPP have to go to nearby market situated at Jaipur which is at least 5 Km away from the township area to get even an ordinary item .

The lack of bare minimum facilities to live inside the township was represented by various employee unions during the past two years. Accordingly,SCCL decided to construct shopping complex, sports complex and other necessary infrastructure to arrange for modest living inside the township area. These buildings will be constructed and will be put to use during 2019-2022.

The development works for existing township like providing roads and drains ,integrating water supply works ,providing fencing around the park, providing protected parking for vehicles and creating club infrastructure will also be taken up in the coming control period.

Extension of armoury building of CISF was required from security point of view. Rain harvesting structures has to be built as per MoEF notification.

Accordingly, a comprehensive capitalization plan for township civil work is prepared for the approval of the Hon'ble commission.

8.2 detailed proposal

The summary of the proposal is placed below:

Capital Investment Plan for township civil works in 2019-2024 (Amounts in Lakhs)						
Sl.No.	Name of Investment	Year in which proposed to put to use			Total (2019-22)	Justification
		2019-20	2020-21	2021-22		
1	Construction of public buildings like shopping complex, sports complex and other necessary infrastructures.	250.00	300.00	364.00	914.00	This is to be constructed to support modest living by persons inside the township.
2	Township Development works like construction of roads, drains & water supply in township, providing electric overhead lines, providing fencing around parks, providing protected parking for vehicles and creating club infrastructure.	315.80	400.00	250.00	965.80	This is to be constructed to support modest living of persons inside the township.
3	Electrification and furniture for CISF.	25.00	-	-	25.00	CISF is deployed to ensure plant security. The proposed expenditure is for arranging moderate living by CISF personnel

4	Extension of armoury building for CISF, CC pavement and rest sheds	60.00	40.00	-	100.00	CISF is deployed to ensure plant security. The proposed expenditure is as per their recommendation to make proper arrangement for security.
5	Parade ground, Stage and roads for CISF	30.00	20.00	-	50.00	CISF is deployed to ensure plant security. The proposed expenditure is as per their recommendation to make proper arrangement for security.
6	Modification to open shed at Guest house into AC Hall	-	100.00	-	100.00	A hall big enough to conduct public gathering with 50 people or more during adverse weather condition is not there in STPP. Therefore the open shed of guest house shall be converted to AC hall. The hall can be used to celebrate days of national importance.
7	Connection of sanitary system of Township to STP	-	60.00	-	60.00	It is required to connect sanitary system of township to sewage

						treatment plant for effective treatment of township sewage.
8	Rain harvesting structures	100.00	100.00		200.00	As per MoEF guidelines, the rain harvesting structure has to be constructed.
	Sub total township	780.80	1,020.00	614.00	2,414.80	

9 Non-scheme capital expenditure

It is to submit before the hon'ble commission that accounting of Property, Plant and equipment is required to be made as per Ind AS 16.

As per this accounting standard, the cost of an item of property, Plant and Equipment shall be recognised as an asset if

a) It is probable that future economic benefits associated with the item will flow to the entity; and
b) The cost of the item can be measured reliably.

However, due to practical difficulty in complying with the robust mechanism for identifying asset as laid out in Ind AS 16, it is very difficult to estimate expenditures in capital assets in future periods as per this standard.

Accordingly, STPP crave leave before this Hon'ble commission to submit the actual capitalisation identified by applying AS 16 during Mid term review and End of control period review for consideration of the commission.

10 Financing Plan:

STPP plans to fund the proposed capital investment through equity and domestic borrowing. The debt: equity ratio is proposed as 70: 30 for the total capital expenditure.

11 The complete proposal

The capital investment plan is given below:

Capital Expenditure scheme:

SUMMARY OF CAPITAL INVESTMENT PLAN FOR FY 2019-24 BASED ON PUT TO USE							
(IN Crores)							
SN	DESCRIPTION	FY 2019-20	FY 2020-21	FY 2021-22	FY 2022-23	FY 2023-24	Total
1	FLUE GAS DE-SULPHURISATION SYSTEM (FGD)	0	0	645.32	0	0	645.32
2	IN-FURNACE MODIFICATIONS FOR NOX MITIGATION	0	19	19	0	0	38
3	OPERATION & MAINTENANCE MODULES	153.10	82.95	65.12	0	0	301.18
4	RAILWAY WORKS	26.94	24.50	79.60	0	0	131.03
5	ERECTION WORKS IN MAIN PLANT	26.91	20.98	8.00	0	0	55.89
6	TOWNSHIP CIVIL WORKS	7.81	10.20	6.14	0	0	24.15
	Total	214.75	157.63	823.18	0	0	1195.57

Non-scheme capital expenditure

STPP crave leave before this Hon'ble commission to submit the actual capitalisation identified as per AS 16 during Mid-term review and End of control period review for consideration of the commission.

12 The spill over items:

The audited capital expenditure for the project upto 30.09.2018 was 8461.94 Crore which was submitted before the commission vide submission dated 28.11.2018. A copy of the same is attached as **Appendix F**. SCCL also projected 360.62 Crs of capital expenditure from 01.10.2018 to 31.03.2018 which is subjected to finalisation of accounts for the financial year 2018-19.

However, it is kindly stated that some of these expenditures may be spilled to the next control period, ie beyond 31.03.2019. The estimated spill over items along with the reasoning is furnished in **Appendix G.** The hon'ble commission

is requested to consider the spill over of this capital expenditures in the control period 2019-24 based on actuals and to consider the same for determination of multi-year tariff 2019-24.

13 Prayer before Hon'ble commission

SCCL prays to the Hon'ble Commission that it may be pleased to:

a. Consider the Capital Investment Plan of STPP during 2019-24 for approval as per regulation 7(b),7.19 and 27 of terms and condition of generation tariff regulation 2019.

b. Grant leave to submit the actual capitalisation identified as per AS 16 during Mid-term review and End of control period review for consideration of the commission

c. Condone any inadvertent omissions/ errors/ shortcomings and permit SCCL to add/ change/ modify/ alter this filing and make further submissions as may be required at a future date;

Petitioner

SUPPORTING APPENDIXES TO CAPITAL INVESTMENT PLAN

Index

APPENDIX-'A'
(OF CAPITAL INVESTMENT PLAN).

(39)

THE SINGARENI COLLIERIES COMPANY LIMITED
(A GOVERNMENT COMPANY)
Registered Office
Kothagudem Collieries (P.O) - 507 101, Bhadradri Kothagudem Dist., Telangana State
CIN: U10102TS1920SGC000571
Environment Dept., 2X600 MW, STPP
Pegadapally(V), Jaipur(M) - 504216, Dist. Mancherial, Telangana State.

Ref: STPP/O&M/ENV/19/38/ 192 Date: 23.01.2019

To
The Secretary,
Ministry of Power
Shram Shakti Bhawan
Rafi Marg, New Delhi - 110001

Sir,

Sub: Compliance of SO_2 emission limit notified vide MoEF&CC Notification S.O. No. 3305 (E), dated 07.12.2015 - Request for time extension for installation of FGD in 2X600 MW Coal Based Singareni Thermal Power Plant (STPP), Telangana State- Reg.,

Ref.: 1. EC Lr. No. J-13012/88/2008-IA.II (T), dated 27.12.2010
2. CPCB Lr.No. B-33014/07/2017-18/IPC-II/TPP/14682, Dt.11.12.2017
3. CPCB ,Divisional Head, IPC-II mail dated:20.08.2018.
4. Lr. No. STPP/ENV/637/1896, Dated:04.09.2018.
5. CPCB Themral Plant review meeting, email dated:05.12.2018.
6. Lr. No. STPP/O&M/Env./18/38/1230,Dt.10.12.2018.
7. CPCB Lr.No.B-33014/07/2018/IPC-II/TPP/14853,Dt.07.01.2019.

***

The Singareni Collieries Company Limited(SCCL) is Government Company having coal mining operations spread over six Districts of Telangana State. SCCL is also operating 1200 MW STPP (2X600MW,Stage-1), near Pegadapally (V), Jaipur (M), Mancherial (Dist.) in Telangana State and is meeting the power requirements of the State. The Commercial Operation Date (COD) has been achieved for Unit-I (1X600 MW) and Unit-II (1X600 MW) on 25.09.2016 and 02.12.2016 respectively.

MoEF&CC accorded Environment Clearance for the 2X600 MW, Stage-I, STPP vide letter cited at (1). It has been stipulated at specific condition no. A (xiv) that provision for installation of FGD shall be provided for future use.

Subsequently, CPCB vide letter cited at (2), directed STPP to take various measures for complying with MoEF&CC Notification S.O. No. 3305 (E), dated 07.12.2015 wherein time lines were stipulated for installation of pollution control equipment. It was stipulated for installing FGD by September 2019 and December 2019 in unit 1 & 2 respectively so as to comply with SO_2 emission limit.

As per CPCB directions, STPP is complying with the norms stipulated for control of PM emissions, Mercury (Hg) and specific water consumption.

As regards installation of FGD for complying with SO_2 emission norms, SCCL awarded the work of preparation of Feasibility Report (FR) and Detailed Project report (DPR) for installation of FGD at 2x600MW STPP to M/s NTPC Ltd. M/s NTPC has prepared DPR and submitted the same to SCCL and the necessary approvals are in under process.

It is to bring to your kind notice that floating of tender, award of work, erection & commissioning of FGD will take at least 36 months. Keeping these aspects in view, STPP submitted a letter to MoEF&CC and CPCB vide letter cited at (4) requesting time extension for FGD installation from December-2019 to December-2022.

CPCB conducted a meeting with all the thermal power plants on 05.12.2018 to review the compliance of norms stipulated vide its Notification, S.O. No. 3305 (E), dated 07.12.2015. On request of STPP for time extension for installation of FGD, CPCB authorities advised to approach Ministry of Power (MoP) for obtaining necessary permission. Accordingly, STPP submitted a letter to Secretary, MoP vide letter cited at (6) with a request for extension of time for FGD installation.

Meanwhile, vide letter cited at (7), CPCB informed to STPP as follows:

"STPP has been directed to comply with SO_2 emission limit by the same timeline which was proposed by the Ministry of Power vide letter No. FU-1/2017-IPC dated 13.10.2017 to MoEF&CC and hence the request made by STPP regarding Stage-I (Unit-1&2) may not be considered".

As STPP has initiated the process of installation of FGD, it is requested to kindly arrange to consider the request of time extension for instalaltion of FGD for 2x600MW STPP, Stage-I (Unit 1&2) from December 2019 to December 2022. It is learnt that your good offices have accorded extension of time lines for FGD installation in the nearby power plant of Telangana State. Hence, similar extension may kindly be accorded to STPP also for completing the installation work of proposed pollution control equipment by December 2022.

STPP is pro-active in implementation of various environmental protection measures in the plant and also assures that the directions of CPCB regarding compliance of environmental norms stipulated vide its Notification, S.O. No. 3305 (E), dated 07.12.2015 will also be complied with.

Yours faithfully,

Executive Director
2x600MW,STPP

Copy to:

1. The Member Secretary (Thermal Sector),
   IA Division,
   Ministry of Environment, Forest and Climate Change,
   Indira Paryavaran Bhavan, Jor Bagh Road, Aliganj,
   New Delhi – 110 003.

2. The Chief Engineer,
   Thermal Project Renovation & Modernization Division,
   Central Electricity Authority
   Sewa Bhavan, RK Puram,
   New Delhi-110066

3. The Chairman,
   Central Pollution Control Board,
   Parivesh Bhawan,East Arjun Nagar,
   Delhi-110032

4. The Member Secretary,
   Telangana State Pollution Control Board,
   Paryavaran Bhavan, A-III, Industrial Estate, Sanathnagar,
   Hyderabad-500018

5. Director(E&M)

6. Director(PP)

7. GM(Env.)

8. GM(E&M),STPP

9. Chief Coordinator, (PPD)/Hyd

10. Chief of O&M,STPP

APPENDIX – 'B'

[of Capital Investment plan]

(42)

THE SINGARENI COLLIERIES COMPANY LTD

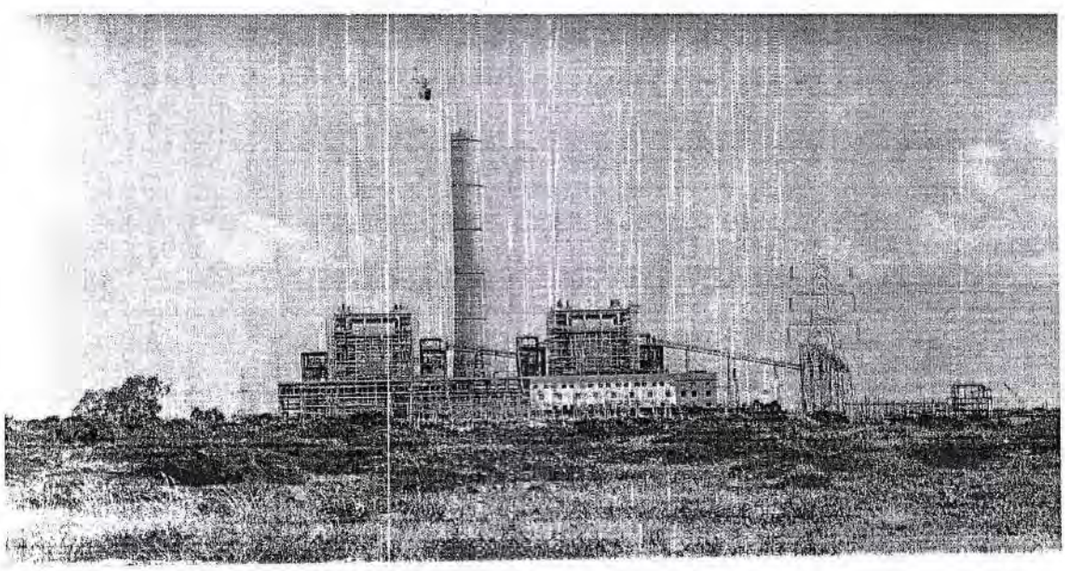
(A Government Company)

DETAILED PROJECT REPORT

FLUE GAS DESULPHURISATION (FGD) SYSTEM

for

2X600 MW Singareni TPP Stage-I, Jaipur(Mandal) Mancherial (District), Telengana State



CONSULTANT

एनटीपीसी NTPC

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CHAPTER-1

RATIONALE OF FGD SYSTEM

1.00.00 MOEF NOTIFICATION FOR SO_x EMISSION

The Ministry of Environment, Forest & Climate Change of Government of India introduced The SO_x emission limit requirement along with NOx emission and suspended particulate limit requirement from thermal power plant vide the Gazette of India on 7th December 2015.

The new standards are aimed at reducing emission of PM10(0.98 kg/MWh), sulphur dioxide(7.3 Kg/MWh) and Oxide of nitrogen (4.8 kg/MWh), which will in turn help in bringing about an improvement in the Ambient Air Quality (AAQ) in and around thermal power plants. The technology employed for the control of the proposed limit of Sulfur Dioxide - SO2 & Nitrogen Oxide - NOx will also help in control of mercury emission (at about 70-90%) as a co-benefit.

The New standard for SO_x emission from thermal power plant are as follows:

Pollutants	TPPs(Units) Installed on or before 31st December 2003	TPPs(Units) Installed after 1st January 2004	TPPs(Units) to be Installed after 1st January 2017
Particulate Matter(PM)	100 mg/Nm^3	50 mg/Nm^3	30 mg/Nm^3
Sulphur Dioxide (SO_2)	600 mg/Nm^3(Units smaller than 500 MW) 200 mg/Nm^3(For Units having capacity of 500 MW or above)	600 mg/Nm^3(Units smaller than 500 MW) 200 mg/Nm^3(For Units having capacity of 500 MW or above)	100 mg/Nm^3
Oxides of Nitrogen	600 mg/Nm^3	300 mg/Nm^3	100 mg/Nm^3
Mercury(Hg)	0.03 mg/Nm^3	0.03 mg/Nm^3	0.03 mg/Nm^3

The provisions for Emission standards from thermal power plant have been further amended vide notification dated 28th June 2018 as follows:

CLAUSE NO.	DESCRIPTION
	"All monitored values for SO2, NOx and Particulate Matter shall be corrected to 6% Oxygen, on dry basis"
2.00.00	**REQUIREMENT OF FGD**
	As the units of SCCL (2X600 MW) come under the category of power generating units commissioned before 31 December 2016, SOx emission need to be controlled below 200mg/Nm^3. As reported the coal based power units at SCCL are operating at SO_X emission value, which is beyond the statutory limit of 200mg/Nm^3 (maximum).
	Accordingly a suitable flue gas desulphurization system is required to be installed in order keep actual SO_X emission value well within statutory limit.
3.00.00	**TARGET SOX EMISSION VALUE FOR SCCL**
	As mentioned above, the applicable SO_X emission limit for SCCL (Units 1 &2) is 200mg/Nm^3. However to take care variation in operating input parameters such as deterioration in coal quality, higher Sulphur content in coal, higher flue gas temperature and flow, higher plant heat rate etc., we need to keep sufficient margin in maximum SO_X emission target from SCCL. Accordingly target value of 100mg/Nm^3 (maximum) for SO_X emission is being considered for design of flue Gas desulphurization system for SCCL.
4.00.00	**IMPLEMENTATION TARGET SCHEDULE FOR FGD SYSTEM**
	Taking into Consideration the technical Challenges and time requirement for installation of FGD and other technologies to meet the new emission limit MoEF&CC vide its letter F. No. Q-15017/40/2007-CPW dated 07.12.17 has directed CPCB to direct all the thermal power plants to ensure compliance with the norms laid down in the 07.12.2015 notification in accordance with the revised plan submitted by Ministry of Power dated 13.10.2017as well as NO_X by 2022.
	Accordingly, as per plan the FGD system at SCCL, Units 1 and 2 (2X600 MW) needs to be implemented within this time limit i.e. by the Dec'2019.
	As per the present status it is not possible to installed FGD system by Dec'2019. Accordingly, a letter was written by SCCL to CPCB & MOP for time extension from Dec'2019 to Dec'2022. (Enclosed).

CHAPTER-2

PROJECT INFORMATION

1.00.00 **PROJECT DETAILS:**

Sl. No.	Item	Details
a)	Place	Near Pegadapalli village, Jaipur Mandal, District Mancherial, Telangana
b)	Location	250 km (approx.) from Hyderabad and 250 km (approx.) from Nagpur
c)	District	Mancherial
d)	State	Telangana
e)	Country	India
f)	Postal Address	Singareni Thermal Power Plant, Pegadapalli, Jaipur, Telangana 504216
g)	Access by Rail	Nearest railaway station is Mancherial railway station on Nagpur-Kazipet main rail line of South Central Railway, located at a distance of about 14.6 kms.
h)	Access by Air	Nearest airport is Shamshabad Airport , Hyderabad at a distance of about 250 KM
i)	Latitude And Longitude of SCCL Thermal Power Station	The latitude and longitude of site are 18° 48' 30" to 18° 50' 35" N and 79° 34' 00" to 79° 35' 30"E respectively
j)	Dry Bulb	29.2 °C (1951 to 1980)
k)	Minimum	19.7 °C

l)	Elevation above mean sea level	156 m
m)	Maximum ambient temp.	45.7^0 C
n)	Wind velocity	Basic, per ISI 44 m/s
o)	Maximum Rain fall intensity	75mm/hr
p)	Seismic Zone	Zone no III as IS-1893-2002

2.00.00 **STAGE & UNITS**

Stage	Unit	Capacity	Date of commissioning
I	I	600 MW	25.09.2016
	II	600 MW	02.12.2016

3.00.00 **FUEL SOURCE:**

3.01.00 Coal: Coal sources are mainly from Srirampur OCM of SCCL and nearby coalmines of SCCL.

3.02.00 Oil: From various HP & IOCL sources

CHAPTER-3

SALIENT DESIGN DATA

1.00.00 FUEL DATA

PRIMARY FUEL ANALYSIS (Design and worst coal)-COAL AS FIRED BASIS

1.00.01 Indigenous Coal Data

S.No.	Characteristics	Unit	Range of 95% coal supplies			Range of 5% coal supplies
			Design Coal	Worst Coal	Best Coal	
1.0	**PROXIMATE ANALYSIS** (As received basis)					
1.1	Total Moisture	%	7.62	6.62	8.04	7.05-12.00
1.2	Ash	%	30.72	37.71	29.32	30.00-48.00
1.3	Volatile matter	%	27.95	25.83	26.37	25.00-30.00
1.4	Fixed carbon	%	33.71	29.84	36.27	35.00-25.00
2.0	**ULTIMATE ANALYSIS** (As received basis)					
2.1	Carbon	C%	49.91	41.63	49.38	40.00-55.00
2.2	Hydrogen	H_2%	2.83	2.50	3.93	2.50.-4.00
2.3	Nitrogen	N_2%	0.85	0.81	1.12	0.50-1.20
2.4	Oxygen (By difference)	N_2%	7.96	8.27	7.81	6.00-9.00
2.5	Sulphur	S_2%	0.42	**0.69***	0.21	0.20-1.00
2.6	Carbonates	CO_2%	0.19	1.77	0.19	0.19-1.77
2.7	Phosphorous	P_2%	None Detected	None Detected	None Detected	None
2.8	Total Moisture	H_2O%	7.62	6.62	8.04	7.50-12.00
2.9	Ash	%	30.72	37.71	29.32	30.00-48.00
2.10	Gross Calorific Value (kcal/kg) (as received basis)	Kcal/Kg	4529	3785	4724	4800-3600
211	Hard grove index		52	60	48	45-70
2.12	YGP Index	(mg/kg)	69.8	61.6	69.8	61.6-69.8

* %S varies from 0.65 to 1.15 (Data furnished by SCCL)

3.0	**ASH ANALYSIS**					
3.1	Silica (SiO_2)	%	67.36	66.11	59.966	55.00-70.00
3.2	Alumina (Al_2O_3)	%	21.28	24.48	23.756	20.00-26.00
3.3	Iron Oxide(Fe_2O_3)	%	8.11	5.57	6.854	5.00-10.00
3.4	Titania(TiO_2)	%	0.00	0.00	0.00	1.00-1.50
3.5	Phosphoric Anhydride(P_2O_5)	%	0.00	0.00	0.00	0.0-0.50
3.6	Lime (CaO)	%	1.60	2.32	5.774	1.50-8.00
3.7	Magnesia (MgO)	%	0.00	0.00	0.00	0.00-3.00
3.8	Sulphuric Anhydride (SIO_3)	%	0.00	0.00	0.00	0.40-0.80
3.9	Sodium Oxide (NaO_3)	%	0.20	0.15	0.192	0.10-0.35
3.10	Balance Alkalies (By Difference)	%	1.45	1.37	3.46	1.25-4.00
4.0	**ASH FUSION RANGE (reducing atmosphere)**					
4.1	Initial Deformation Temperature (IDT)	^0C	1400	1380	1342	1150-1400
4.2	Hemispherical temperature	^0C	1400	1400	1400	1300-1400
4.3	Flow temperature	^0C	1400	1400	1400	1400-1400

2.00.00 **WATER QUALITY**

Clarified Water Analysis

Sl. No.	Constituent	as	mg / litre
1	Calcium	$CaCO_3$	103
2	Magnesium	$CaCO_3$	96
3	Sodium & Potassium	$CaCO_3$	172
4	Bicarbonate	$CaCO_3$	146
5	Chloride	$CaCO_3$	100
6	Sulphate	$CaCO_3$	122
7	Corbonate	$CaCO_3$	Nil
8	Silica	SiO2	21
9	Iron	Fe	0.06
10	pH Value	-	7.84
11	Turbidity	NTU	5.00
12	Temperature (°C)		27.1

Cooling/ CW Blowdown Water Analysis

Sl. No.	Constituent	as	mg / litre
1	Calcium	$CaCO_3$	515
2	Magnesium	$CaCO_3$	480
3	Sodium & Potassium	$CaCO_3$	860
4	Bicarbonate	$CaCO_3$	730
5	Chloride	$CaCO_3$	500
6	Sulphate	$CaCO_3$	610
7	Corbonate	$CaCO_3$	Nil
8	Silica	SiO2	105
9	Iron	Fe	0.3
10	pH Value	-	8.5
11	Turbidity	NTU	25
12	Temperature (°C)		27.1

Note : The CW system is expected to operate at about 5.0 cycles of concentration (COC)

Filtered Water Analysis (Drinking Water)

Sl. No.	Constituent		mg/ litre
1	Calcium	$CaCO_3$	101
2	Magnesium	$CaCO_3$	94
3	Sodium & Potassium	$CaCO_3$	174
4	Bicarbonate	$CaCO_3$	145
5	Chloride	$CaCO_3$	103
6	Sulphate	$CaCO_3$	122
7	Corbonate	$CaCO_3$	Nil
8	Silica	SiO_2	21.0
9	Iron	Fe	0.06
10	pH Value	-	7.88
11	Turbidity	NTU	2.17

Analysis of DM Water

Sl. No.	Characteristics		Value
1	Silica (Max.)	-	0.02 ppm as Sio2
2	Iron as Fe	-	Nil
3	Total hardness	-	Nil
4	pH value	-	6.8 to 7.2
5	Conductivity	-	Not more than 0.1 us//cm excluding The effects of free CO_2

CHAPTER-4

DIFFERENT DESULPHURIZATION PROCESSES

1.00.00 **INTRODUCTION:**

SO_2 emission from fossil fuel fired power plants is proportional to the fuel Sulphur content, although with respect to coal a small percentage, usually less than 10% is absorbed by ash. Power plants in India traditionally use a very low/medium grade coal with low/medium Sulphur content. The SO_2 emissions from SCCL (2X600 MW) are in the range of ***2000-3500 mg/Nm³*** considering sulphere in coal in range of 0.65%-1.15% (100% BMCR Condition).

The power plant is expected to release about 10-16 tons per hour of SO_2, without any emission control. It may not be possible to achieve adequate control of SO_2 by dispersion alone and SO_2 emission control mechanism will become necessary for the plant.

2.00.00 **SO_2 CONTROL PHILOSOPHY**

As discussed above, the estimated SOx emission from SCCL is approximately 09-15 times the SOx emissions permitted by the new environment norms. In view of the MOEF norms in India, controlling the SO_2 emission from the SCCL is necessary.

It is therefore, proposed to reduce the SO_2 emission from each unit by at least 90% on a sustained basis, which will result in a net emission of 200 mg/Nm³ (approx.). However, to account for change in coal Sulphur content during the plant life and some performance deterioration, the Desulphurization system shall be designed to achieve a SO_2 reduction of 95%.

DIFFERENT DESULPHURIZATION PROCESSES

The selection of Desulphurization process depends on a number of factors including technical suitability, economic aspects and commercial considerations. Technical suitability includes the suitability of the process for the fuel under consideration, ability to achieve the required SO_2 reduction efficiency and turn-down capability of the process. The economic aspect includes the capital cost of the plant, the operation cost including the cost of auxiliary power, cost of sorbent, disposal cost of the byproduct and market for the scrubber by-product, if any. The sorbent utilization will be a major criterion for selection as the cost of transportation of the limestone is likely to be very high. The commercial considerations include the availability of proven technology for the process, availability and successful operation of the previously installed Units and guarantees offered by the vendors.

A wide range of technologies is available to reduce the SO_2 from burning of coal. This includes:

i. Fuel Desulphurization

ii. In Bed SO_2 removal

iii. Flue Gas Desulphurization System

In the case of SCCL, Units 1 and 2 (2X600 MW), since the units are already in operation, option of in Bed removal is not applicable.

3.00.00 **FUEL DESULPHURIZATION**

3.01.00 A major portion of Sulphur (30 – 70%) in coal is usually present in the form of pyrites or FeS_2. The pyrites have high specific gravities and can be removed by washing. Other chemical processes are available to remove the organically bound Sulphur from coal.

Coal washing is generally used for removal of ash and is not a common practice for high-grade coals. The efficiency of this process depends largely on the percentage of pyrites and it may not be possible to achieve the desired reduction in Sulphur by this method alone. Besides, the process generates a huge amount of waste with a significant combustible content. The coal desulphurization process is very expensive compared to other desulphurization processes and are rarely used in large-scale plants.

The rejects generated from the washing process is also a source of other environmental problems like ground and soil water contamination.

As stated above, Coal desulphurization is a very expensive method for reduction of SO_2 emission and may lead to other environmental problems. It may also not be possible to achieve the desired level of SO_2 control by this method, for high Sulphur coals.

Therefore, this process is not considered suitable for SCCL(2X600 MW).

3.02.00 **FLUE GAS DESULPHURIZATION**

Nearly all flue gas desulphurization processes depend on the fact that SO_2 is acidic in nature and use an alkaline substance, most commonly lime or lime stone to neutralize it. Other alkalis like sodium based, magnesium-based alkalis and other type of alkalis such as Ammonia etc. are also used. FGD processes may be broadly classified into three different types:

i) Semi dry / dry process

ii) Wet FGD process

iii) Dry Sorbent Injection System

3.02.01

DRY/SEMI DRY PROCESS

Dry FGD technologies include the more established spray dryer absorber (SDA) system, which sprays a fine dry must of lime into the flue gas, and the relatively new concept of employing circulating fluidised bed (CFB) technology, with boiler ash and lime circulated through an absorber reactor and typically a fabric filter.

Dry scrubbing technology has much lower capital cost and uses less water than wet FGD technology but in the past has generally only been selected for projects where the boiler size was not too large and the fuel Sulphur level was not too high. The various semi dry technologies are discussed below.

A. Spray-Dry Process

Spray Dryer Absorption (SDA) is a dry scrubbing process that is generally used for low-sulfur coal. SDA FGD systems are typically located after the air preheaters, and the waste products are collected either in a bag house or electrostatic precipitator. However, to achieve sulfur dioxide (SO_2) reduction above 80% with good reagent use, the dry scrubber is generally followed by a baghouse.

Flue gas is treated in an absorber by mixing the gas stream concurrently with atomized lime slurry droplets. The lime slurry is atomized through rotary cup spray atomizers or through dual fluid nozzles. Some of the water in the spray droplets evaporates, cooling the gas at the inlet from 140 ^{0}C or higher to 70^{0}C to 80^{0}C, depending on the relationship between approach to saturation and removal efficiency. The droplets absorb SO_2 from the gas and reacts the SO_2 with the lime in the slurry. The desulfurized flue gas, along with reaction products, unreacted lime, and the fry ash passes out the dry scrubber to the bed-house.

In spray-dry process, a very finely atomized spray of very thick slurry of the sorbent is introduced into the flue gas stream upstream of the ESP or bag filter. The normal sorbent for the process is quick lime, which is slaked at site to generate Calcium hydroxide. SO_2 reacts with $Ca(OH)_2$ to form calcium sulfite, which then collected with ash in the ESP or bag filter. The gas and the sorbent may be mixed either in a spray-dryer vessel or in the duct.

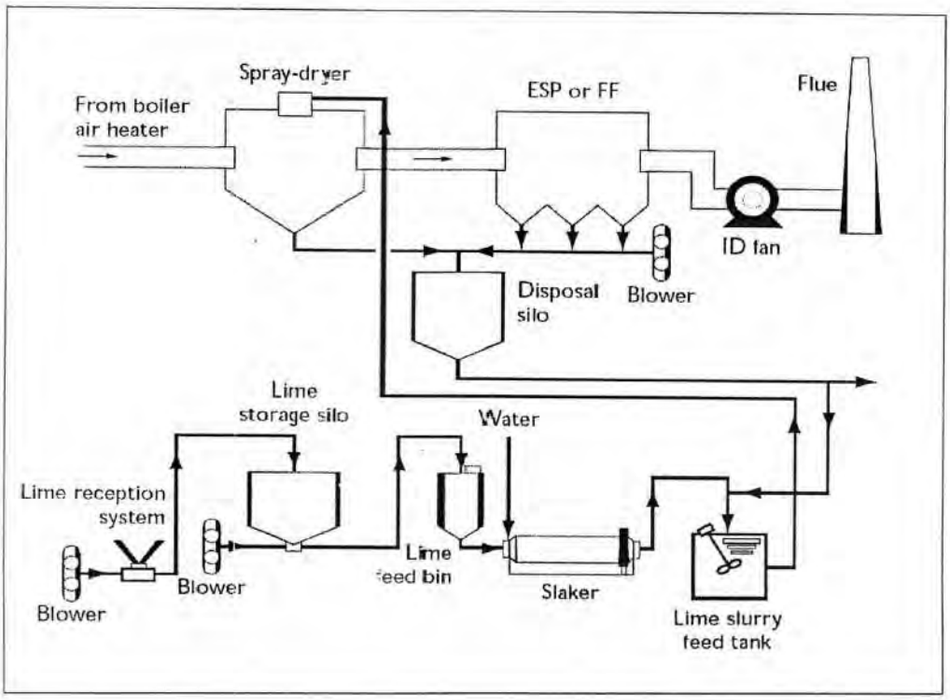
The SO_2 absorbed in the atomized slurry reacts with lime in the slurry to form calcium sulfite ($CaSO_3$) in the following reaction:

$SO_2+CaO+1/2\ H_2O=>CaSO_3.1/2\ H_2O$

A part of the $CaSO_3$ reacts with oxygen in the flue gas to form calcium sulfate

($CaSO_4$): $CaSO_3 +1/2\ O_2 + 2H_2O => CaSO_4.2H_2O$

The process can achieve a removal efficiency of 90-95%, with a spray-dryer vessel, for medium Sulphur (up to 2.5%) coals. The semi-dry is one of the lowest capital cost option for desulphurization of flue gas, typically being about 70% of the cost of the Limestone-gypsum plant.



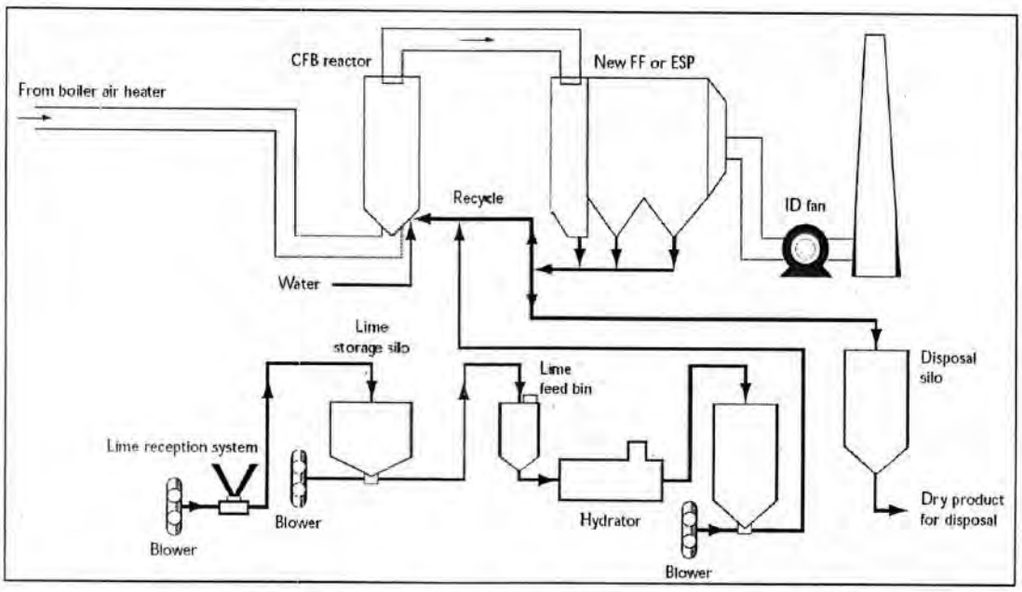
The spray-dry FGD process is suitable for low and medium Sulphur coal, where a desulphurization efficiency of 90% can be achieved with the process. However, the operating cost of the process is among the highest due to poor utilization of lime, high pressure drop in the Bag Filter, additional handling requirement for lime and waste generated from the process and O&M cost of operating a Bed Filter.

For the above reasons, the process is not being considered for SCCL (2X600 MW) because of its high capital & operational cost.

B. CFB / CDS Process

In the Circulating Fluidized Bed (CFB) FGD or Circulating Dry Scrubber (CDS) process, flue gas from the air heater is carried through the inlet venturi throat through a fluidized bed of lime, reaction products and fly ash particles contained within the vertical reactor tower. Here the lime reacts with SO_2 to produce a mixture of calcium compounds. The gas is then passed through an ESP or Fabric Filter where the ash

and calcium compounds are collected. The clean gas is then discharged through the ID fans and Stack. The normal sorbent for the process is lime which is slaked at site to form calcium hydroxide (slaked lime).



The process is capable of achieving up to 97% removal of the SO_2 and all of the SO_3 and HCl from the flue gas. It is a relatively simple process and has low space requirement. The capital cost of the process is low and the process has very good turn down capability.

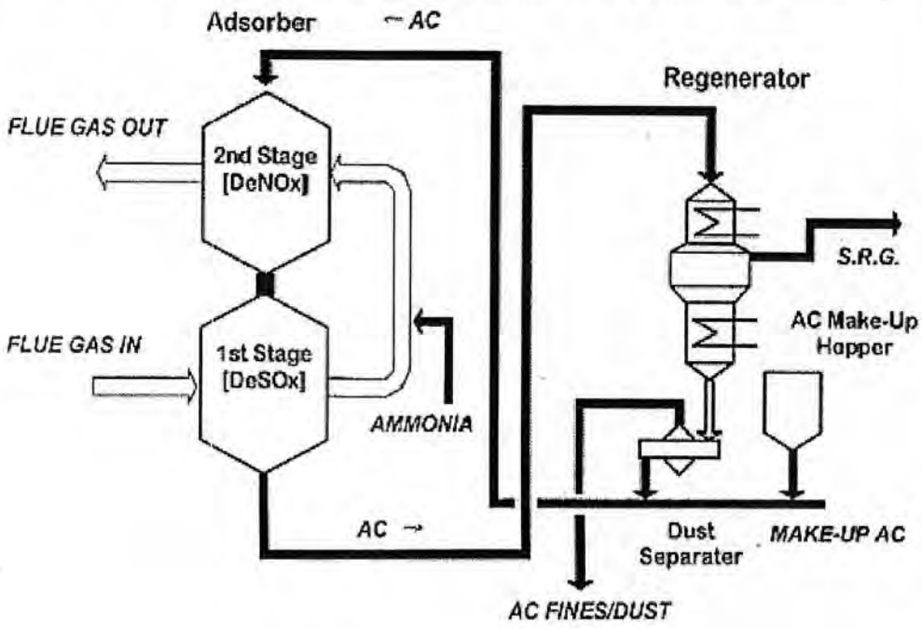
However, the sorbent utilization of the process is similar to the spray-dry process with Ca-S molar ratio of 2-3. The normal sorbent for the process is lime, which is costlier than limestone. Further, the product of the chemical reaction is a mixture of calcium compounds, sulfite and sulfates, along with unutilized lime and ash. The by-product is not saleable and has to be disposed, which further increases the operational cost of the system. Further, there only a few such installations with unit size above 250 MW.

Although the CFB process is very simple compared to Wet FGD systems and has a lower capital cost, the operational cost is among the highest (similar to the spray-dry process) due to its poor lime utilization, costly reagent and additional cost incurred in handling the lime and waste generated from the process.

The process is not being considered for SCCL (2X600 MW) because of its high operational cost and limitation in references.

C. Combined De-SOx / De-NOx Process

Another new development in dry process is the combined SOx – NOx removal process. This is a cold end process after the ESP in which the flue gas is passed through two beds of activated coke. SO_2 is absorbed by activated coke in the first bed after which NH_3 is introduced in the flue gas which then passes through the second bed of activated char. The coke here, acts as a catalyst for reduction of NOx to N_2. The saturated coke from the first bed is regenerated continuously in another chamber which produces a very concentrated stream of SO_2. This can be used to produce a commercially saleable elemental Sulphur or sulphuric acid.



The SO_2 removal efficiency of such process is up to 95-99%. The process has the added advantage of ~90% removal of NOx. However, the combined process is very complex with a very high capital cost.

The process is still in the developmental stages with not many units in operation across the world. The process has therefore, not been considered for SCCL (2X600 MW).

3.02.02

WET PROCESS

In the wet process, thin slurry of sorbent is sprayed into the flue gas streams, typically after the ash has been removed in the ESP. The water dissolves most of SO_2 from the flue gas to form H_2SO_3 which then reacts with the sorbent. Lime stone

and quick lime are some of the most commonly used sorbents, although other sorbents like ammonia, sodium & magnesium are also used commercially. One particular process, uses the natural alkalinity of sea water to scrub SO_2 in a process called sea water washing.

The wet FGD system is located downstream of the ESP. Most wet systems have an additional capability of removing a significant percentage of inlet dust. This allows a smaller ESP for controlling SPM, the remaining reduction occurring in the FGD system.

A. Lime / Limestone-Gypsum Forced Oxidation (LSFO) Process

In this process, thin lime or limestone slurry is sprayed in the flue gas. Alternatively, the flue gas passes through a bed of lime / limestone slurry. The reactions between lime / lime stone slurry and SO_2 produces a mixture of calcium sulfite and calcium sulfate. The calcium sulfite sludge is further oxidized in an oxidized tank to yield $CaSO_4.2\ H_2O$ or gypsum.

$$SO_2 + H_2O = H_2SO_3$$

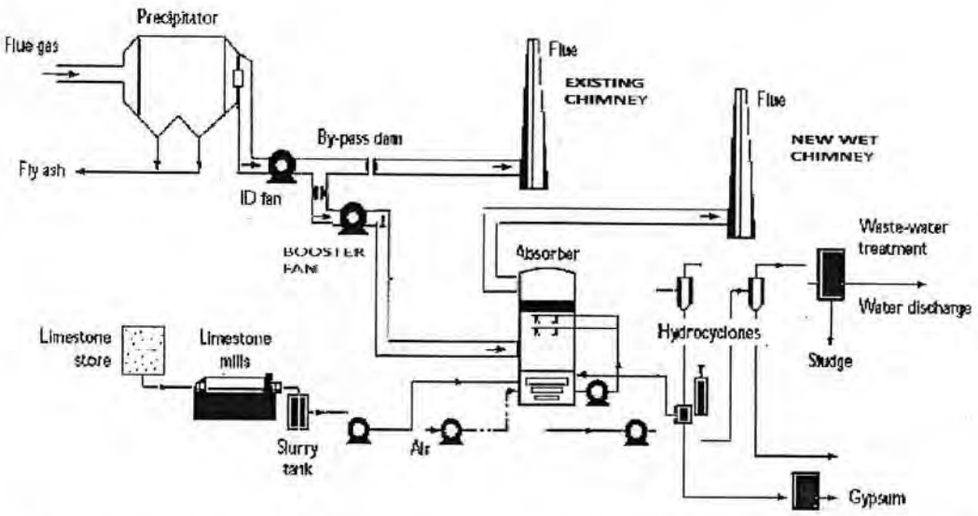
$$CaCO_3 + H_2SO_3 = CaSO_3.½H_2O + ½H_2O + CO_2$$

$$CaSO_3.½H_2O + 1½H_2O + ½O_2 = CaSO_4.2H_2O$$

The gypsum slurry is bled off from the tank and dried in a Dewatering plant, from where the gypsum is taken for sale.

The LSFO process is capable of achieving up to 98% SO_2 removal for high Sulphur coals which makes it highly suitable for the proposed plant. Further, the process is well proven with a number of operating units and manufacturers. The process operates with very low Ca/S molar ratio, typically in the range of 1 to 1.1, which brings down the operating cost, particularly when sorbent utilization is vital to plant economics.

Further, the gypsum by-product of the process is marketable and helps bring down the operating cost further. However, the wet LSFO FGD process is a very complex as compared to the dry process and requires a large foot print area.



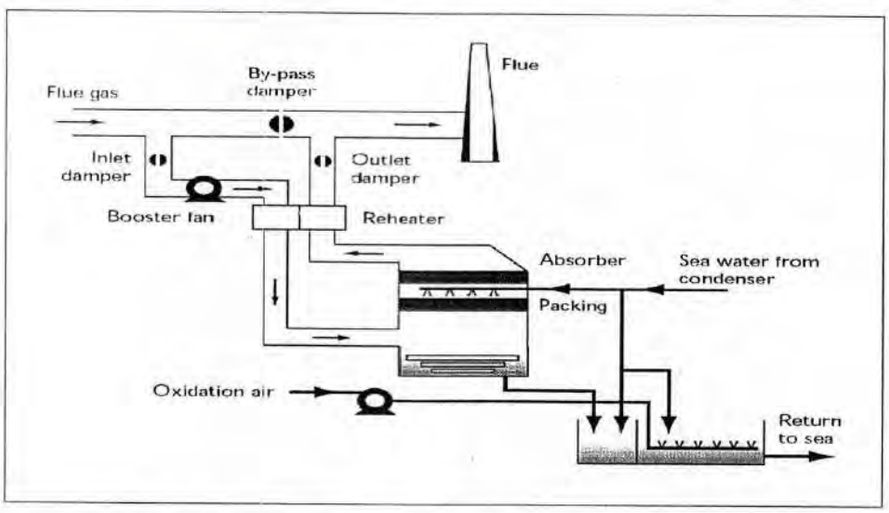
The choice of reagent depends on the availability, cost and other issues like handling. The lime requirement per ton of SO_2 removal in a wet process is typically 56% of the limestone requirement. However, this difference is off set by the higher cost of lime as compared to limestone. The availability of high quality lime from local source is another issue which favors the use of limestone. In view of the above factors, limestone is the chosen reagent for the wet limestone based FGD system.

The process is the most well proven technology to achieve high desulphurization efficiency with high Sulphur coal, with a large number of reference plants. The high capital cost and auxiliary power consumption of the process are partially off-set by the high sorbent utilization and sale ability of the gypsum by-product.

The above process is the most suited for SCCL (2X600 MW). Other Wet systems are costlier due to higher cost of reagent and higher energy consumption. Accordingly, this system is selected.

B. Sea Water Process

The sea-water washing (SWW) process uses natural alkalinity of the untreated sea water in order to neutralize the SO_2. The gas from ID fan passes through a booster fan (optional) into the scrubber, where sea water is sprayed into the flue gas. The sea water dissolves most of the SO_2 and practically all of HCl. The clean gas is again passed through a re-heater before discharge through stack.



The acidified liquor is collected in a sump and then taken to a mixing basin where more sea water is mixed and air is blown through the water to reduce its chemical oxygen demand, before being discharge into the sea. Most sea water applications, utilize water from condenser water box outlet, which is partially used for scrubbing and the remaining for neutralization of the acidified liquor.

The sea water process is a very simple process with no requirement for any additional reagent. The sea water is capable of achieving desulphurization efficiency upto 95% with low and medium Sulphur coal. However, their efficiency with high Sulphur coal is limited by the huge amount of water that will be required for such applications.

Since this process is applicable only to coastal power stations and hence not considered for SCCL (2X600 MW).

C. Ammonia Process

The process is similar to the LSFO process, except that the reagent is an aqueous ammonia solution. The reaction between Ammonia solution and SO_2 produces a mixture of ammonium sulfite and sulfate. The ammonium sulfite sludge is further oxidized in an oxidization tank to yield Ammonium sulfate ($(NH_4)_2SO_4$) which can be used as fertilizer.

$$SO_2 + H_2O = H_2SO_3$$

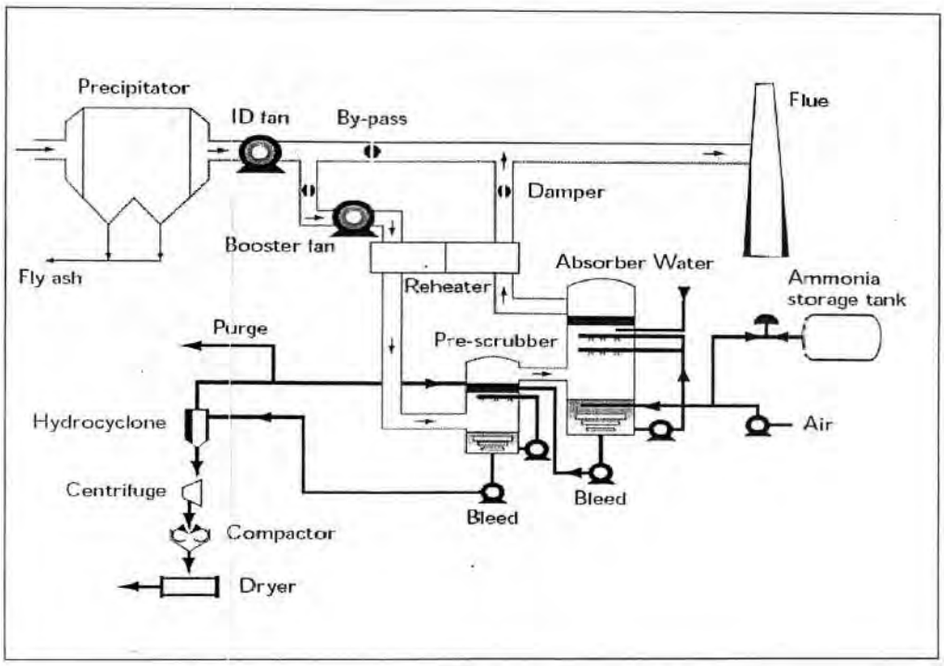
$$2NH_3 + H_2SO_3 = (NH_4)_2SO_3$$

$$(NH_4)_2SO_3 + \tfrac{1}{2}O_2 = (NH_4)_2SO_4$$

The $(NH_4)_2SO_4$ slurry is bled off from the tank and dried in a Dewatering plant, from where the $(NH_4)_2SO_4$ is taken for sale or disposal.

The Ammonia FGD process is capable of achieving upto 98% removal of SO_2. The byproduct of the process $(NH_4)_2SO_4$ is a very high value fertilizer, the sale cost of which can offset the operating cost.

The process is very high in capital cost and has very high auxiliary power consumption (2-3%). **The storage and handling of aqueous ammonia is potentially risky and proper planning is required**. The system requires a large foot print area, similar to the limestone gypsum FGD system.

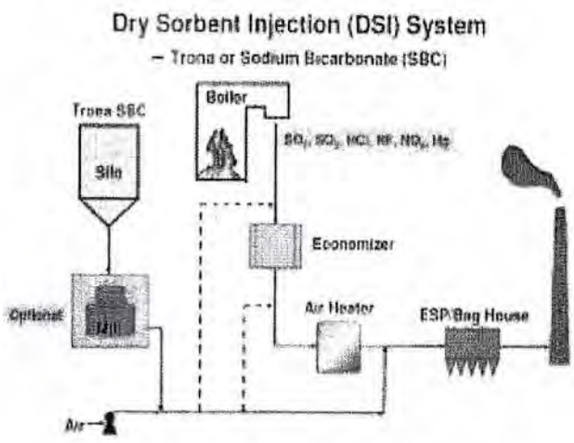


The Ammonia Process is not being considered for the SCCL (2X600 MW) because of their high capital cost, high auxiliary power consumption and lack of adequate reference plants

3.02.03 **DSI TECHNOLOGY**

A Dry Sorbent Injection (DSI) system is a dry process in which a sorbent is pneumatically injected either directly into a coal-fired boiler or into ducting downstream of where the coal is combusted and exhaust (flue) gas is produced. The goal of the sorbent injection is to interact the sorbent with various pollutants in the flue gases (such as sulfur trioxide (SO_3), various acid gases including hydrochloric acid (HCl), and sulfur dioxide (SO_2), such that some fractions of these pollutants are removed from the gas stream. After the appropriate chemical interactions between the pollutants in the flue gas and the sorbent, the dry waste product of reaction is

removed at the existing particulate control device downstream of the injection point- which is either an electrostatic precipitator (ESP) or a fabric filter baghouse.



DSI is a mature technology that has been widely applied since the early 2000's by utilities in the USA requiring SO_3/HCL/HF emissions reduction. DSI offers the following benefits over other acid gas control technologies:

1. Low installed capital cost w.r.t Wet Limestone FGD & semi dry FGD.
2. Relatively easy to retrofit (only injection lances are in contact with exhaust gas) with very short unit shutdown time.
3. System has good process flexibility for various sorbents and ability to easily modulate based on unit load and/or different fuels.
4. Small equipment footprint (typically footprint of one or two silos and Mill/Blower building)
5. Relatively short installation schedule as there is approximately less than one year schedule from contract award to commercial operation.
6. No water requirement
7. Low Auxiliary Power consumption
8. Easy to operate

Sorbents

Two primary sorbents are utilized in DSI systems: (a) Sodium based sodium bicarbonate or Trona and lime based hydrated lime ($Ca(OH)_2$). Sodium Bicarbonate is more effective in removing SO_2 emissions than hydrated lime. Although hydrated

lime effectively mitigates SO_3, it is less effective in mitigating SO_2. In most of the cases, hydrated lime is used to remove SO_3, HCl and HF primarily these are very reactive acidic pollutants compared to SO_2 with hydrated Lime.
To mitigate SO_2 with hydrated lime, water must be added to the process to reach acceptable performance levels. The water is needed to facilitate the reaction of hydrated lime and SO_2. Further reactivity of hydrated lime as compared to sodium bicarbonate with SO_2 is much lower requiring 6 to 10 times the stoichiometric requirement for SO_2 capture compared to 1 to 1.5 for Sodium Bicarbonate. This parents and added level of difficulty in designing a cost effective solution.

Coal being fired in the plant contains around 35-40% ash. Further, for low SO_2 removal efficiency required to meet the norms the sodium bi carbonate consumption will be very less. In such a scenario the sodium content in fly ash will not exceed more than 0.6%-1% which is much less than the permissible 1.5% alkali content in fly ash.

The Operational cost of DSI system is very high because of high cost of sorbents. Further Process is only suited for low PLF and low SO_2 removal efficiency .So this process is being not suited for SCCL (2X600 MW) because of its very high operating cost, low SO_2 removal efficiency .

Comparison of Different FGD technologies

Item	Spray Dry Process	CFB / CDSDry	Wet Limestone-Gypsum	Ammonia process	DSI
Sorbent	Lime	Lime	*Limestone*	Ammonia	Sodium bicarbonate
Coal Sulphur Limit	For low and medium Sulphur content coal	Nc limit	*No Sulphur content limit*	No Sulphur content limit	For low and medium Sulphur content coal
Removal efficiency	90-95%	Above 95%	*Above 95%*	Above 95%	<85%
Process	Hard to obtain	Hard to obtain	*Local*	Depends on availability	Depends on availability
Sorbent source	Hard to obtain	Hard to obtain	*Local*	Depends on availability	Depends on availability

Sorbent Utilization	Poor	Poor	*Good*	Good	Poor
By-product	Waste Mixture of Calcium compounds (Sulfite and sulfates)	Waste Mixture of Calcium compounds (Sulfite and sulfates)	*Gypsum*	High value fertilizer Ammonia sulfate solution	Along with Fly Ash
Aux. Power	Low	Low	*High*	Very High	Low
Capital Cost	Low	Low	*High*	High	Low
Operating Cost	High	High	*Low*	Low	Very High
Reference Plants above 500 MW	Few	Few	*Many*	Few	Few

CHAPTER-5
PROPOSED WET LIMESTONE FLUE GAS DESULPHURISATION SYSTEM

The wet FGD process is considered a commercially mature technology and is offered by a number of suppliers. The reliability on the wet FGD has been increased substantially in recent times.

As discussed in the previous section and seen in Table, the Wet Lime/ Limestone Gypsum Process is selected for SCCL (2X600 MW) Stage-I for the following reasons:

i. Ability to achieve high desulphurization efficiency
ii. High Dust removal as a co-benefit.
iii. High reagent utilization factor or Low reagent consumption rate.
iv. Reagent material (limestone) used by the process is plentiful and readily available.
v. Saleable By-product (gypsum).
vi. Large number of reference plants.
vii. Maturity of technology involving minimum commercial risks and large number of suppliers resulting in enhanced competition.

The FGD shall be designed to achieve high SO_2 removal efficiency of ~95% with reliable & proven design to achieve high availability. Further, the FGD system is having additional advantage of reducing the dust burden substantially.

It is proposed to market the by-product gypsum by locating suitable buyers.

1.00.00 **WET LIMESTONE FGD SYSTEM**

Various systems required for the wet limestone scrubbing process are:

a. Booster Fans
b. Limestone Transportation
c. Limestone Handling System
d. Milling System
e. The FGD Absorber
f. Gypsum De-watering system
g. Gypsum Handling System
h. Process Water Distribution System
i. ECW system
j. Waste Water Treatment System

Description of the selection and sizing of various above systems to meet the desired requirements of efficient operation & life of the plant shall follows:

1.01.00 **DESIGN CONSIDERATION**

The FGD system shall be installed downstream of the ID fans and shall be based on wet Limestone Forced Oxidation Process. The FGD system shall be designed to achieve the required SO_2 capture without the use of any other additives. Only field proven materials for similar application shall be used for the system. The FGD System shall be designed so as to be in operation whenever the Steam Generator is in operation Each unit shall be provided with an independent wet absorber. Sufficient redundancies shall be provided in all the auxiliaries to achieve high availability of the system, to match the unit availability. The absorber shall be designed so that all maintenance in the absorber shall be carried out during the planned annual overhaul, without requiring any bypass. A bypass for the FGD unit shall also be provided. The bypass will be used only in case of emergencies for maintenance of the absorber.

1.02.00 **BOOSTER FANS:**

The Booster Fans shall be located downstream of the ID Fans (Induced Draft Fans) in the inlet duct to Absorber shall be capable of handling the pressure drop in the FGD system & ducting and wet stack of 200 m height also considering the exit loss from wet stack over the entire load range.The gas from ID fan discharge shall be boosted up using two no of booster fans. Sizing of booster fans shall include the sufficient margin to accommodate 100 mmwc pressure drop (approximately) for installation of future (Selective Catalytic Reduction) SCR (if required).

Each fan to be sized with following conditions occurring together at design point		
I.	Type of fans	Constant speed, axial type
II.	No. of fans in operation	2
III.	Margin over flow	20%
IV.	Margin over pressure requirement	44% over the calculated head value excluding the static head
V.	Power supply frequency	50 Hz
VI.	Pressure at Booster Fan suction	0 mmWc
VII.	Gas temperature (degree Celsius)	150
VIII.	Flue gas control	Blade pitch control

1.03.00 **LIMESTONE TRANSPORTATION**

Limestone is proposed is to be transported through road and unloaded at the power plant end. The daily requirement of limestone for plant shall be approximately 650 ton considering outlet emission of 100 mg/Nm3 at 100% plant load factor. As per coal flow data and Sulphur percentage in coal, lime stone requirement and Gypsum production is calculated and indicated in table below for 100 %, 90 %, 80 % and 70 % PLF.

The calculation is based on 1.15 % of Sulphur (data furnished by SCCL) content in coal & target emission of 100 mg/Nm3

PLF	100%	90%	80%	70%
LIMESTONE (T/Day)	650	585	520	455
GYPSUM (T/Day)	1085	980	870	760

1.04.00 **LIMESTONE HANDLING SYSTEM**

It is assumed that Lime stone of approx. 250 mm shall be received in power plant through road transport and unloaded at lime stone handling area of proposed FGD Plant .

Lime stone shall be unloaded and conveyed by double stream conveyors of 100 TPH capacity to the crusher house for sizing it to -20 mm.

Limestone shall be unloaded into the Underground Hopper from the Limestone Stack out area. The Underground Hoppers include Rack and Pinion Gates and Belt Feeders which feed limestone onto the Belt Conveyors. Belt Conveyors transfer the limestone to the Limestone Crushers through Rack and Pinion Gates.

Each Limestone Crusher is designed to crush the limestone rock, and then discharge it onto the Belt Feeders and Bucket Elevators, and to be sent to the three numbers of Limestone Storage Silos having capacity of 1800 T each (07-08 days storage capacity).

The crushed limestone will be conveyed from the three no of Limestone Storage Silos to the dedicated 24-hr storage Limestone Bins/mill bunker through Rotary Feeders, Belt Feeders and Bucket Elevators(if required) in the Limestone Grinding building.

The storage silos and hopper cones shall be fabricated of minimum 10 mm thick carbon steel with a SS lining of grade SS304 of minimum 4 mm thickness in the complete cones to ensure reliable discharge of material.

The design of storage silos shall confirm to IS 9178 (Part 1 to 3). The storage bin shall be capable of feeding the limestone by means of gravimetric feeder to the wet ball mills. The top of the unloading hopper shall be equipped with a grate to protect the downstream equipment from gravel lumps or tramp waste.

Dust suppression & dust extraction system, ventilation system, potable water and service water system shall be provided throughout the Lime stone handling plant.

1.05.00 **BASIS FOR SELECTION OF MILLING SYSTEM:**

Lime stone requirement

To cater to any change in coal Sulphur content during the plant life and deterioration in mill performance, it is proposed that the milling system shall be designed with a minimum margin of 10% above the maximum requirement of the station. The milling system for the FGD can be either common or unitized i.e. independent milling system for each unit.

Since the unitized system requires additional space in the unit area, Common milling system has been envisaged with one working and one stand-by mills. Two alternatives were explored for the common milling system.

Two common type of milling system employed for wet FGD process are the dry milling system and the wet milling system.

1. In dry milling systems, the limestone is ground in air medium and compressed air is used for conveying the pulverized limestone to a storage silo from where a gravimetric belt feeder feeds measured quantity to the lime slurry preparation system. For proper grinding, the limestone has to be dried prior to feeding to the mill and the limestone moisture at mill inlet has to be limited to 1-2%. This may require an additional hot air supply system for drying of limestone in case the crushed limestone has higher moisture. The dry mills typically have a longer life for the wear parts but consume more power for grinding & transportation. The capacity of the mill is also reduced compared to wet mill of the same volume.
2. In wet milling system, slurry of crushed limestone is fed to the mill. The pulverized limestone slurry is classified in a single or multi-stage hydro cyclone and stored in a storage tank, from where it is pumped to the absorber. The wet milling system have a lower power consumption but also a lower wear life due to heavy erosion by liquid slurries. However, wet milling system is widely preferred due to their lower operating cost and overall requirements of the unit, which needs slurry feed to the absorber.

In view of the above, it is proposed to have a wet milling system for FGD

Horizontal wet ball & tube mills are the most preferred choice for FGD installations, through vertical medium speed mills are also used. However, the fineness required for the FGD limestone power is typically above 90% through 325 mesh for which the horizontal ball mills are more suited. Horizontal ball mills have the capability of grinding an average feed size of ¾" & 1" to the required fineness. A new development in FGD applications is the use of vertical ball mill. The power consumption of these mills is lower than that of horizontal ball mills. However, they require a typical feed size of about 1/4", which increase the crushing requirements.

The horizontal ball mills, being the most widely used & proven system for FGD applications, are also proposed for SCCL (2X600 MW).

There shall be common milling system as two number horizontal/vertical wet ball mills, 1 working & 1 standby, common for the two units. Each mill shall be sized to meet the following conditions, occurring together:

i	Load	100% BMCR
ii	Ca/S Ratio (for Mill Sizing)	1.1
iii	Input Feed Size	1"
iv	Output fineness	Not less than 90% through 325 mesh or as per the requirements of the FGD absorber, whichever is more stringent.
v	Capacity	110% of limestone requirement of all the absorbers at Design point with the mill wear parts in nearly worn out condition.

The mill shall have a peripheral drive system with necessary speed reducers. In addition, an emergency auxiliary drive shall also be provided to prevent settling /solidification of limestone when the mill is out of operation and also for maintenance purpose.

Each mill shall be fed from an independent bunker through a gravimetric belt feeder. The gravimetric belt feeder shall be sized to meet 110% of the mill maximum demand and shall have a variable speed drive and weighing instruments to accurately control the feed rate. The belt shall be of rubber, while all other internal parts shall be of Stainless Steel construction.

The dry feed from the feeder shall be mixed with process water in a hopper and fed to the mill through trunnion on one side of the mill. The ground limestone slurry shall be discharged through the mill trunnion at the other end into a settling tank. The mill discharge slurry shall be pumped to single or multi-stage hydro-cyclones from where the fine product slurry shall be taken to slurry storage tank while the coarse slurry shall be mixed with the mill inlet feed.

Each mill shall be provided with an independent mill separator tank and hydro-cyclone. 2x100% slurry pumps shall be provided for each separator tank.

The hydro-cyclone over flow of the required fineness shall be taken into two common lime slurry storage tanks, each sized for minimum storage capacity of 12 hours' requirement of 2 units operating at 100% BMCR. For tank volume calculation, solid concentration (by weight) in the slurry shall be assumed, not more than 20% or actual required whichever is lower.

The limestone shall be pumped from the slurry storage tank to the individual FGD units by 2x100% slurry pumps for each unit. A 100% stand-by pipeline shall also be provided. The slurry pump shall be sized to meet the required capacity with a maximum of 30% solid weight in the slurry. The pumps shall be equipped with a VFD motor or a hydro-coupling for control of flow. The pumps shall be sized to meet the following criteria, all conditions occurring together:

Load	100% BMCR (both units)
Maximum Solid Concentration at inlet to hydro-cyclone	Max. 30% by weight
Ca/S Ratio	1.1
Maximum Solid Concentration	30%
Flow	110% of one absorber requirement with the limestone requirement at Design point.
Head	As system requirement to meet the above flow
Margin on Flow	Minimum 10%
Margin on Head	Minimum 15%

All the tanks shall be provided with sufficient no. of agitators to prevent deposition of solids at the bank. All the agitators shall be motor driven with power supply from emergency system.

The mills shall have replaceable rubber lining bolted to the mill shell. The lining shall have a minimum wear life of 2 years. The limestone slurry pumps and the pipelines shall be of CS construction with replaceable elastomer or rubber lining with a minimum wear life of 2 years.

1.06.00 **ABSORBER SYSTEM**

The wet limestone spray absorber shall be deigned to achieve an outlet SO_2 emission of 100mg/Nm_3 at 6% O2 (dry) with the following conditions occurring together:

a) Flue gas flow & inlet SO_2 concentration
b) Flue gas temperature

Load	100% BMCR
Excess air economizer outlet	20%
APH air in leakage	15%
Duct air-in leakage	2%
ESP air-in leakage	1%

The absorber shall be either a spray type absorber, with single or multiple levels of spray, or an absorber with gas bubbling through the slurry. In Spray type absorber wet limestone slurry shall be sprayed in the tower by slurry recirculation pumps taking suction from the absorber tank. The absorber shall have single or multiple levels of spray nozzles, as per the proven practice. Each level of spray nozzles shall have an independent slurry recirculation pumping system. In Bubbling Type absorber, no recirculating pump and spray header and nozzles shall be required in such case. However, Gas Cooling Pumps instead of Slurry Recirculation shall be provided

1.06.01 **ABSORBER TOWER**

The efficiency of the wet limestone SO_2 scrubbing system depends on the following absorber related factors:

i. Flue gas velocity
ii. Liquid to gas volume flow (L/G) ratio
iii. Recirculation slurry pH
iv. Ca/S molar ratio

During earlier times, the flue gas velocity through the absorber was kept below 3.0 m/s to give sufficient residence lime for the gas to react with atomized slurry. However, during recent times with improvements in design of various components, the latest FGDs have a much higher velocity up to 4.5 m/s.

Increasing the flue gas velocity increases the SO_2 removal efficiency of the liquid and the absorbers can operate with a lower slurry flow rate to achieve the same efficiency, which significantly reduces the pumping power.

However, it also leads to an increased gas side pressure drop and a higher mist carryover, which may lead to a plugging of the mist eliminator. The velocity of the flue gas through absorber shall, therefore, be limited to 4 m/s.

Wet limestone FGD process operates with a very high L/G ratio. However, increasing the gas velocity through the absorber has brought down the L/G ratio due to higher mass transfer. The minimum L/G ratio of the absorber shall be 20 liters per 1000 m^3 of gas for effective removal of SO_2.

SO_2 removal efficiency of a wet limestone process increases with increasing pH. However, above 6.2 pH, the oxidation of calcium sulfite to gypsum becomes difficult and this can lead to scale formation. The pH of the absorber slurry shall therefore, be regulated between 5.5 to 6.2 for effective removal of SO_2 and oxidation of calcium sulfite to gypsum.

The SO_2 removal efficiency increases with increasing Ca/S molar ratio. However, wet limestone process is capable of achieving very high SO_2 removal efficiency with very low Ca/S ratio. Further, in order that the gypsum produced is saleable, the molar ratio should not exceed 1.03, which means about 97% utilization of limestone.

The absorber tower shall be therefore sized with the following parameters at 100% BMCR:

Flue gas velocity:	4 m/s (max)
L/G ratio :	20 L/1000m3(min)
pH :	5.5 to 6.2
Ca/S ratio:	1.03 max

1.06.02 **SLURRY RECIRCULATION PUMPS**

The absorber shall have single or multiple levels of spray nozzles. Each spray level shall have an independent pumping system. The capacity of the pumps

shall be sufficient to maintain an L/G ratio of 20L per 1000m^3 of gas at BMCR. The maximum solid concentration in the recirculation slurry shall not exceed 30%.

In case the absorber has a single level of nozzles, there shall be a minimum of 3 pumps of 50% capacity each. For multiple spray levels, 2x100% pump shall be provided for each level. Alternatively, a spare absorber spray level with independent pump can be provided. It shall be possible to reduce the slurry flow rate at lower loads to save power. For this purpose, the pump shall be provided with a VFD motor or a variable scoop hydro-coupling drive.

The absorber recirculation pumps shall be sized to achieve a minimum L/G ratio of 20 liters per 1000 m3 of gas or actual predicted, whichever is higher, at BMCR without the spare pumps / spray levels working. Further each pump shall be designed with the following margins to cater to deterioration in performance due to wear of impeller liners:

i. Flow: minimum 20%

ii. Head: minimum 20%

The number, capacity and spread of the spray nozzles shall be in line with the proven practice and shall be adequate to cover the whole absorber cross-section uniformly without too much impingement in the absorber walls. A minimum of 5% redundancy shall be provided in the spray nozzles at each level to ensure adequate coverage with a few choked nozzles.

1.06.03 **ABSORBER TANK**

The absorber shall have an integrated oxidation tank at its bottom. The tank shall be sized to provide a minimum mean residence time of 12 hrs for the slurry to be oxidized to gypsum.

For oxidation of calcium sulphite to gypsum, the absorber shall have a grid type oxidation system or a sparge jet oxidation system or lance type or air rotary sparge system or jet air sparger system , as per the proven practice. The tank should be equipped with a sufficient no. of agitators to work in conjunction with the oxygen sparging system to keep the slurry in continuous motion.

The oxygen required for oxidation shall be supplied by 2x100% oxidation air blowers for each absorber. The compressor/blower shall be sized to supply at least 2.5 times the stoichiometric air requirement for spray tower process & at least 4.0 times the stoichiometric air requirement for Bubbling Type process or the actual requirement, whichever is higher, under the following condition, all-occurring simultaneously. The natural oxidation of sulfite by residual oxygen in flue gas shall not be considered for this purpose.

Load	100% BMCR
Flow	Minimum 2.5 times for spray tower process & 4.0 for Bubbling Type process, the stoichiometric requirement.
Head	For spray tower process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 8500 mmwc whichever is higher. For Bubbling Type process actual requirement considering choking/ blockage of minimum 10% of the oxidation nozzles / sprayers or minimum 3500 mmwc whichever is higher.
Margin on Head	10% under above conditions.
Ambient Conditions	45°C / 60% RH.

Oxidation nozzles / spargers shall have a minimum redundancy of 10% .The oxidation system shall be complete with a quenching system to cool down heated oxidation air in order to prevent any scaling or buildup that could occur at the sparger tips due to localized evaporation of recycled slurry.

1.06.04 **MIST ELIMINATORS**

The clean Flue gas from the absorber tank shall be demisted in a three stage chevron type Mist Eliminators (ME). Provision shall be made for continuous washing of both ends of the first & second stage and the front section of the third stage of mist eliminators. Wash water arrangement shall also be provided at the back end of the third stage of mist eliminator.

1.06.05 **EMERGENCY SPRAY SYSTEM**

An emergency cooling system for automatic spray of quenching water for a sufficient time (minimum 15 min) at the inlet to the absorber, in case the gas temperature exceeds the design temperature due to failure of upstream equipment's shall be provided to protect the FGD and all other sensitive downstream equipment against high flue gas temperatures. The water shall be supplied from an elevated tank (emergency water tank) installed near to the absorber. The tank volume and the injection lances/nozzles shall be designed to protect the inlet duct and the lining of the absorber

1.06.06 **AUXILIARY ABSORBENT TANK**

One Number auxiliary absorbent tank shall be provide for both unit, sized to contain the complete slurry of one absorber tank at its maximum level equipped with all

necessary pumps, agitator, valves, piping and controls to transfer the tank's contents back to the absorber to refill the absorber sump It should be possible to discharge the each absorber into the Auxiliary Absorbent tank within 2 hours. The contractor shall provide 1 x100% pump to pump back the slurry from the sump back to the absorber in a maximum time of 8 hours.

1.06.07 **CONSTRUCTIONAL FEATURES / MATERIALS OF CONSTRUCTION**

The FGD absorber shall be self-supported from the bottom to suit site conditions. The absorber shall have adequate stiffening arrangement from the external side. Internal stiffeners shall be used only when it is not possible to provide proper external stiffening.

The inlet duct to the absorber from the booster fans shall have provision for automatic spray of quenching water if the temperature at this section exceeds the design temperature of the absorber, due to failure of the upstream equipment. For multi-level spray absorbers, a minimum distance of 1.5m shall be kept between two spray levels for ease of maintenance. All the agitators shall have supply from the emergency power supply.

The choice of material for various sections of the FGD absorber is very critical as they are subject to varying degree of corrosion & abrasion. The material shall be able to withstand localized pitting & crevice corrosion due to conditions of low pH and high sulphuric / sulphurous acid & chloride concentration. The early FGDs absorber tower typically used CS casing lined with rubber. However, these faced repeated failures due to failure of the rubber lining exposing the parent material to corrosive attack. The liners in most FGDs absorber have been replaced with either with 2mm (min) thickness Alloy C276/Alloy59 in the absorber tower.

The absorber inlet sections, including the portion of inlet duct subject to splashing liquids from the spray zone, are subject to a very severe environment of low pH, coupled with high acid concentrations. The wet dry interface may also be subject to scaling which can lead to localized pitting attack. The inlet zone shall be of 7 mm carbon steel with a 2 mm thick plate equivalent to or better than Alloy C276 / Alloy 59 or equivalent wall paper or cladding. This area shall also be provided with sufficient flushing /washing arrangement to prevent scale formation.

The main absorber spray zone operates with a comparatively higher pH but may be subject to severe erosion from the sprays. This zone may be 7 mm thick CS with 2 mm thick wall papering made of C 276 / Alloy 59. Alloy C276 / Alloy 59 is a costlier option but is known to give a better corrosion resistance. The absorber outlet duct from top of the spray nozzles to the chimney shall be of CS with min 7mm thickness cladded with 2mm (min) thickness Alloy C276/Alloy59/Titanium Gr-II.

The mist eliminators are proposed to be of chevron type made of polysulfone or SS along with continuous washing system.

The spray piping and headers & the oxidation headers shall be of FRP, or CS with rubber lining (min 10mm natural rubber lining) chemically & abrasion resistant on both inner & outer surfaces.

The Auxiliary Absorbent tank shall be made of minimum 7 mm thick carbon steel with minimum 4 mm thick rubber lining of best quality bromine butyl rubber

Oxidation tanks shall have a 2 mm thick cladding of C276/Alloy 59 over 7 mm thick CS.

Component	Material
Absorber Inlet Flue Duct	CS with min 7mm thickness
Absorber Wet Dry Interface	CS with C276 / Alloy 59 cladding
Absorber & Oxidation tanks	CS with min 7mm thickness cladded with 2mm (min) thickness Alloy C276/Alloy59
Absorber Outlet Duct up to Chimney	CS with min 7mm thickness cladded with 2mm (min) thickness Alloy C276/Alloy59/Titanium Gr-II
Mist Eliminator	Polysulfone or stainless steel
Spray Piping / Header	FRP or CS with rubber lining

1.07.00 **GYPSUM DEWATERING SYSTEM**

Gypsum slurry from each absorber tank shall be pumped by 2x100% variable speed pump (for each unit) to the common dewatering system. The slurry shall have 15-30% solid concentration (by weight) as per the standard practice of the manufacturer. A 100% stand-by pipeline shall also be provided. Each pump shall be sized with a minimum margin of 10% on flow and pressure over 120% of the maximum flow requirement from the absorber at 100% BMCR

In order that the gypsum produced in the absorber is saleable, the same has to be dewatered to ensure less than 10% moisture in the gypsum. Most FGD systems in the world use a two stage dewatering system, where the primary stage consisting of sets of hydro-cyclones increases the solid content in the slurry to 45-60%. This thick slurry is further dewatered to less than 10% moisture in a secondary dewatering system.

The secondary dewatering system is either a vertical basket centrifuge or a vacuum belt filter.

1. Vacuum basket centrifuges have a batch discharge which may lead to cake heeling. They are also high in capital cost, require a larger amount of water for cake washing and have higher maintenance requirements due to high operating speeds.

2. The vacuum belt filters have a continuous cake discharge and have a very low wash water requirement. They are also lower in capital cost. However, the filter cloth may require frequent replacement.

The vacuum belt filter system along with a primary dewatering system consisting of multiple sets of hydro-cyclones is therefore chosen for the project.

Providing an independent dewatering system for each unit will require a large number of hydro-cyclone / belt filters because each unit will require an independent stand-by arrangement

A common gypsum dewatering system 2 X 100% for both unit operating at design point is proposed with each stream sized to dewater 110% of the maximum gypsum produced by both units operating at design point. The two stage gypsum dewatering system, consisting of a primary stage of sets of hydro-cyclones and secondary stage of vacuum belt filters for dewatering of gypsum. Each belt filter shall be capable of removing 90% of the moisture from gypsum. They shall have a minimum two stages of cake washing to remove other impurities from the gypsum coke. The filtrate from gypsum slurry and from cake washing shall be taken to vacuum receiver tank.

The primary hydro-cyclone shall be installed directly above the belt filters. The overflow of the primary hydro-cyclones shall be taken to a secondary hydro-cyclone feed tank for feeding the secondary water hydro-cyclones. The underflow from primary hydro-cyclone shall be taken to belt filter. The overflow from secondary hydro-cyclone shall be taken to a waste water tank. The under flow water from secondary hydro-cyclone and water from vacuum receiver tank(s) shall be taken to a common filtrate tank for recirculation to the absorber tanks.

Each set of primary dewatering hydro-cyclone shall be sized to dewater the gypsum slurry produced by both units operating at design point with an additional 10% margin.

Each belt filter shall be fed from either set of hydro-cyclone. Each hydro-cyclone & belt filter shall be sized to meet 110% of the maximum requirement of both absorbers at 100% BMCR. Further, each set of hydro-cyclone shall be provided with at least 10% spare hydro- cyclones.

Each set of hydro-cyclone / belt filter set shall be sized to meet the following requirements, occurring together:

Load	100% BMCR (both units)
Maximum Solid Concentration at inlet to hydro-cyclone	Solid 30%
Flow	110% of a both unit's maximum gypsum production.
Outlet Moisture	10%

Gypsum Purity	90% minimum

The gypsum dewatering pumps and the pipelines shall be of CS construction with replaceable elastomer or rubber lining with a minimum wear life of 2 years. The hydro cyclones shall have replaceable rubber lining. The filter cloth shall be polyester or polypropylene and shall have a life of minimum 6 months. The cloth shall be continuously tracked to avoid slippage. The drive belt (if provided) shall be of rubber construction.

The dried gypsum cake shall be discharged through a hopper & a belt conveying system to the gypsum storage shed.

1.07.01 **GYPSUM HANDLING & DISPOSAL SYSTEM**

It is estimated that the FGD shall produce **1000-1100 tons** of gypsum per day for SCCL (2X600 MW). This by product can be used by cement manufacturers located in the proximity of the power plant. The covered storage shed for gypsum shall be sufficient to store gypsum equivalent to consumption of minimum 7 days at Design point (Generation of both units to be considered). Also the space for additional covered shed for gypsum storage has been identified. Gypsum storage area may be further enhanced as per requirement subject to space availability.

1.07.02 **ECONOMIC UTILIZATION OF BYPRODUCT/GYPSUM**

The byproducts quality depends mainly on the quality of the raw material. The specific properties of an individual FGD gypsum are dependent on the composition of the fuel and limestone used, as well as the process design. Moisture content and crystal size and shape are also important to the gypsum. FGD gypsum can be produced at purity levels well over 90%, to equal or surpass the quality of many sources of natural gypsum. High quality gypsum may be sealable to cement industries.

Gypsum will be disposed-off to nearby cement industry and land filling/road construction. The suitable area in existing ash slurry pond may be marked to disposed-off to existing ash dyke in case, there is no buyer available . SCCL (2X600 MW) may float Expression of Interest for exploring the potential buyers.

1.08.00 **PROCESS WATER DISTRIBUTION SYSTEM**

Two (2) Process water Storage tanks along with two numbers of 2x100 % Booster water pumps, if required, (Each pump catering to the process water requirements of both units) to feed the blowdown water (tapping from CW system/service water system) to process water tank. Each process water storage tank shall be designed to store 30 minutes of total maximum water required for the entire FGD process (including absorber system and mist eliminator washing system, limestone grinding and slurry preparation system and gypsum dewatering system, etc.) for the units operating at Design point. 2x100% Process Water Pumps & 2x100% Mist Eliminator

CLAUSE NO.	DESCRIPTION
	Wash Water Pump shall be provided for both unit connected to each of the Process water Storage tanks.
1.09.00	**COOLING WATER SYSTEM (ECW SYSTEM)**
1.09.01	A centralized/combined ECW system is envisaged for both FGD system auxiliaries. In the primary circuit, Demineralised cooling water (DMCW) pumps shall discharge cooling water through plate type heat exchangers (PHE) for cooling of the FGD system auxiliaries. The outlet header from plate heat exchangers shall be suitably branched off to supply cooling water to the to the individual Flue Gas Desulphurization system Auxiliaries coolers. Outlet from these auxiliary coolers shall be connected back into a common return header and led back to the suction of DMCW pumps to complete the closed loop primary cooling circuit. The secondary circulating water system shall receive water through a tapping from CW blowdown water. This water will be further pressurised by a set of auxiliary cooling water booster pumps and fed through the plate type heat exchangers and the discharge secondary water from PHEs shall be used as process water for FGD system.
1.09.02	For the primary cooling circuit, an overhead tank of minimum (normal) capacity of 5 Cu.M shall be provided by the bidder. Outlet of this tank shall be connected to the closed circuit return header. Make up to the closed loop primary circuit shall be taken from the DM water transfer pumps located near DM water storage tank and emergency make up from the discharge of condensate transfer pumps. The make-up would be given to overhead storage tank.
1.09.03	**Major ECW system shall be comprising of** (a) SCCL shall provide one cold water header tapping from CW Blowdown from CW pump discharge pipe/service water tank. Water requirement shall be 400-430 T/hr (b) SCCL shall provide DM water tapping from each normal and emergency DM make up system (existing) for makeup requirement. Make up water requirement shall be 01-02 T/hr (c) Hot secondary water pipe from the PHE's, discharging into the FGD system as process water. (d) 2x100% capacity self-cleaning strainers on the secondary side. (e) 3 x 50% (2 working + 1 standby) capacity of plate type heat exchangers. (f) 4 x 50% (2 Working - 2 standby) capacity FGD Auxiliary (Secondary) Cooling water pumps, along with drives. (g) 3 x 50% (2 Working + 1 standby) capacity FGD DM (Primary) cooling water pumps along with drives.

(h) One Overhead DM water tank (ECW O/H tank).

(i) Alkali (Sodium Hydroxide) preparation tank, agitator and motor, piping, valves etc.

(j) Piping for normal makeup to ECW tank from existing DM water transfer pump, piping for emergency makeup to ECW tank from condensate transfer pump, other piping, fittings, supports, valves and specialties including instrumentation and electrical equipment as required and as specified for the system.

1.10.00 **EFFLUENT & WASTE TREATMENT AND DISPOSAL SYSTEM**

Installation of zero liquid discharge for FGD Plant will be costly and hence it is suggested to discharge waste water to ash slurry sump. The approximately discharge of waste water will in range of 35-40 m^3/hr.

1x100% Waste water tank shall be provided which shall be sized for 8 hrs storage of waste water with all the units operating at Design point. The Waste water Tank shall be complete with Agitator, level transmitters etc. The waste water collection tank shall be of Steel construction with rubber lining. 2x100% horizontal centrifugal pumps shall be provided for pumping the waste water from tank to ash water sump . The waste water shall be neutralized (lime dosing) before discharge.

2.00.00 **AC & VENTILATION SYSTEM FOR FGD PLANT**

Control room for FGD Plant will be provided with D-X Type Air Conditioning system and all building and Switch gear room will be provided with supply and exhaust fan ventilation system.

3.00.00 **FIRE DETECTION AND PROTECTION SYSTEM:**

Tapping for hydrant/HVW/MVW system shall be provided by employer from nearby existing header.

1 **Hydrant System:**

Complete hydrant system (pipe, hydrant valves, landing valves, water monitors, hoses, branch pipes and nozzles etc) for FGD area shall be provided as per TAC norms.

2 **HVW Spray System:**

Automatic fire detection cum high velocity water spray system shall be provided for various transformers (having oil capacity 2000 liters or more) envisaged under FGD system.

3 **MVW Spray System:**

Automatic fire detection cum medium velocity water spray system for the

various cable galleries envisaged under FGD system.

4

Fire Extinguishers

The following quantity (minimum) of fire extinguishers and installation of the same at various locations of FGD system as per TAC requirement.

Pressurized water type (9 lit. capacity as per IS 15683): 5 Nos.

CO_2 type (4.5 kg Cap IS:15683): 5 Nos.

Dry chemical type (6 kg Cap IS:15683) : 5 Nos.

4.00.00 **COMPRESSED AIR SYSTEM**

The compressed air system shall consist of Air compressors (2 X 100%) & their motor drives, Air Drying (ADPs) Plants, air receivers for each Air compressors, instrumentation and control, control panels, compressed air piping, Instrument Air Piping network, service air-piping network etc.

Air from air compressors shall be dried in respective Air Drying Plants in compressor house and delivered to the Air receivers. From the Compressed air piping header at the downstream of Air receivers, one common header to be provided to meet the service and instrument air requirement for FGD.

5.00.00 **GUARANTEES**

The Proposed Performance Guarantees which attract Liquidated Damages (LD) are as follows

1. SO_2 removal Efficiency
2. Limestone consumption of FGD system
3. Auxiliary Power Consumption
4. Availability of FGD Plant

Guarantees (The parameters/capabilities shall be demonstrated for various systems/ equipment)

1. Wet ball Mill capacity at rated fineness
2. Wet ball Mill wear parts guarantee
3. Wet ball Mill ball consumption
4. Vacuum Belt Filter Capacity
5. Gypsum Purity
6. Waste Water consumption
7. Performance characteristics of fans (capacity, head developed, etc.)
8. Margins on fans in case Booster Fan is provided by the Contractor.
9. Passenger cum Goods Elevator for FGD absorber & Limestone Grinding Building:

10. Noise
11. Mist Outlet Droplet Content
12. Availability of FGD Plant
13. Air Conditioning System
14. Ventilation System
15. Compressed Air System
16. Equipment Cooling Water System

CHPATER-6

FGD CIVIL

1.00.00 LAND DEVELOPMENT

Topography of the proposed site for FGD plant is more or less flat with minor undulations. Natural ground levels in the FGD plant area, as per contour map, varies from RL (+) 145 to 150m. Area propcsed for the FGD plant, has already been levelled at the time of construction of the existing power plant. The main plant block formation level or finished ground level (FGL) is at RL (+) 144.0m. The Flue Gas Desulphurization (FGD) unit shall be coming up beyond the existing chimney. The FGL of chimney area is at RL 144.00m. Thus, FGL for FGD unit is being considered at RL (+) 144.00m.

1.01.00 GEOTECHNICAL DATA & FOUNDATION SYSTEM

As per Geotechnical investigation report soil investigation has been carried out (in 2010) before carrying out site levelling for stage –I area. Based on the relevant borelogs from chimney area referred from above Geotechnical Investigation Report, it is seen that, in general, sandy silty clay/ clayey silty sand layer is met from the ground surface to about 2.8 to 4.00m depth. This stratum is underlain by Brownish & Grayish very Dense Silty Fine Sand With ranging from 4.00m to 8.00m which is followed by decomposed rock/ highly weathered sandstone of thicknesses ranging from 8.00 to 30.00m and extending up to the final explored depth in most of the boreholes. Ground water table as observed in the boreholes at the time of investigation (2010) was encountered at depths ranging from 3.00 m to 3.5m below the existing ground level.

As per above report, results of chemical test on soil and ground water samples indicate that no special protective measures are required for cement and reinforcement during construction. Portland Pozzolana Cement (PPC) has been considered for foundations with grade of concrete as M25. Minimum slope of 1V:1.5H for deep excavation is to be considered.

Type of Foundation System:

Existing power plant facilities are supported on open/ shallow foundations. Accordingly, FGD System including lime storage & disposal arrangement shall be supported on open foundations (isolated/ combined/ raft foundation). Chimney may be provided with annular raft/ full raft foundation at suitable depth. The foundation system for FGD system units as wel chimney shall be adopted based on the geotechnical investigation to be carried out by the contractor during detailed engineering.

1.02.00 **FGD SYSTEM UNITS.**

1.02.01 **Structural System**

1. Lime Stone Crusher House

Crusher house shall be of structural steel with permanently color coated steel sheet cladding. Floor slabs shall be of RCC. Crushers shall be supported on RCC deck slab which in turn will rest on vibration isolation system consisting of springs & dampers. Ironite flooring has been considered for floors.

2. Crushed Lime Silo

Silo of adequate number and volume of structural steel will be specified in mechanical portion along with covering overhead structural shed and access platforms/walkways shall be provided.

3. Cable and Pipe Racks

Structural steel trestles and galleries with provision of walkway with grating shall be provided for supporting overhead cables and pipes in the main plant and outlying areas. However, for below ground routing, RCC trench with removable pre-cast concrete covers / box culverts shall be provided.

4. Limestone Conveyor Galleries & trestles.

Overhead limestone conveyor shall be of structural steel frame with cladding and roofing. Transfer points and intermediate supporting trestles shall be made of braced steel framed structures. The staircase shall be of external type.

1.02.02 **Under Ground Structures:**

1. Limestone Underground Reclaim Hoppers including Tunnel and Pent house

Tunnel from reclaim hopper to pent house shall be of RCC construction with chemical injection grouting and polymer modified cementitious coating as water proofing treatment. Ironite flooring will be provided on tunnel flooring. The hopper and gratings shall be designed for movement of front end loader/ bulldozer over them.

Pent house shall be of R.C.C framed structures with columns, beams, slabs and foundations etc.

1.02.03 **Other Buildings/ Structures:**

1. Gypsum Storage Area

These shall be R. C. C. framed structures with columns, beams, slabs and foundations etc. Cladding shall be of 230mm thick brickwork with plastering on both sides.

2. Electrical cum Control Room Building

It shall have RCC framed structural arrangement with brick cladding & RCC roof slab. Control room shall be air-conditioned area with false ceiling.

3. Mill Recycle Pump House

Pump houses shall have RCC framed structural arrangement with brick cladding & metal deck roofing filled with RCC.

4. Auxiliary and equipment cooling water pump house

5. Civil Foundation/structure for Tanks:

a. **Makeup Water Tanks**
b. **Absorbent Tank**
c. **Waste Water Tank**
d. **Filtrate Water Tank**
e. **Secondary HC Feed Tank**
f. **Auxiliary Steam Tank**

1.02.04 **Civil Concepts**

Control room internal partitions shall be provided with single or double glazing in aluminium framework. Roof shall be provided with elastomeric membrane or other suitable water proofing treatment.

Windows shall generally be of aluminum. Doors of control room and office area shall be of aluminium frame with glazing or particle board panels. All fire exits shall be provided with fire proof doors. Hollow metal doors shall be provided for switch-gear room, cable vaults etc.

Entire FGD plant area shall be provided with paving in combination with interlocking concrete blocks and high wearing resistant concrete.

1.02.05 **Architectural Concepts**

a. All buildings and structures shall be architecturally treated in such a way so as to be in complete harmony with the existing main plant building, surrounding structures and environment. Due considerations shall be given to landscape design, and interior design All finishes for floors, walls, ceiling, structural elements, partitions for offices and industrial areas shall be suitable for their aesthetics, durability and functional requirements and shall include the latest building material & technology.

b. Overall color scheme of the FGD system shall be designed judiciously in line with the existing color scheme of main plant building and in a comprehensive manner taking into account the mass and void of buildings, its facade, equipment, exposed structural elements, piping, trestles, bus ducts, and other service elements.
c. For adequate light and ventilation, National Building Code recommendations shall be followed.
d. All the buildings shall be architecturally designed to meet the National Building Code requirement.
e. During design stage, Technical specification as prepared shall govern the finishes as well as quantity.
f. Human safety factors shall form firm basis of design criteria.
g. Due consideration shall be given to preserve and protect the existing Landscape during the construction, reduce air pollution during construction and provide for minimum level of sanitation and safety for construction workers.
h. All public buildings shall be designed on the principles of providing barrier free environment for physically disabled persons.
i. All the buildings shall be designed to take care of Rain Water Harvesting & Ground Water Recharging.
j. Overall emphasis shall be on developing eco-friendly architecture, merging with the nature with its own sustainable energy management systems.

1.03.00 **CHIMNEY**

Provision for one new twin flue reinforced concrete chimney with cladding of Titanium/C-276 alloy/ Borosilicate Glass Block on mild steel liner for the two 600 MW units of the project has been kept in the layout. The flue gas emission point shall be **200** meters above the plant grade level. The RCC for the chimney shell and other super structure shall be of M-30 grade (using only OPC cement) and for foundation & grade level slab it shall be of M-25 grade.

Liner shall essentially be constructed from structural steel and shall be of the hung type (with multiple point liner support system). The liner shall be provided with resin bonded wool type thermal insulation. The portion of the liner projecting above the chimney roof, however, shall be constructed of shaped acid resisting bricks. Brick liner shall be protected by a reinforced concrete mini-shell also constructed from the roof slab. Suitable expansion joints shall be provided between the steel and the brick liner. Internal platforms shall be provided for enabling access to various elevations of the stack and to provide support to the steel liner. There shall be at least one meter

working space around the flues. External platforms, staircase & lift shall also be provided.

The structural steel transition inlet ducting shall be bottom supported. This transition ducting shall be suitably profiled from a rectangular shape at the chimney inlet to a circular shape up inside the chimney where it shall be connected to the suspended circular steel liner through suitable (non-metallic) fluroelastomeric fabric expansion joints. Transition ducting shall also be thermally insulated.

Internal platforms shall be of structural steel construction. The chimney roof shall, however, comprise of a reinforced concrete slab supported over a grid of structural steel beams. The external platforms shall be of reinforced concrete construction of grade M-30. An internal structural steel staircase, supported from the shell wall, shall be provided for full height of the stack. Suitable embedments shall be provided in the shell wall for this purpose. An internal ladder shall be provided having its support from the concrete shell inside the chimney and shall be provided for a small height, over the last staircase landing, to access the chimney roof through a roof access hatch. External ladders shall be provided on each of the mini-shell(s) over the roof.

The flooring panels of the platforms and treads of the staircase shall be of chequered plate construction. Handrails for platforms and staircase shall be of tubular construction.

The external portion of the wind shield shall be coated with alternate bands of red and white colors to meet the aviation safety requirements. The mini-shells and the top few meters of the internal surface of the windshield shall be painted for acid and heat protection with bituminous paint.

The other components of the chimney include cast iron caps over mini-shell(s), liner test ports (for continuous pollution monitoring), liner hatches, reinforced concrete roof slab protected for acid and heat protection, grade level slab of reinforced concrete with a metallic hardener floor finish, a large electrically operated grill type roll-up door (with only the bottom small portion of the curtain of solid shutter type) at grade level and personnel access metallic doors at grade level and at all floors, a personnel access hatch in the roof slab, rain water drainage system, flue liner drainage system, roof drain basin, louvers with bird screens for ventilation openings and all gaps in the wind shield, mild steel discrete strakes, painting of chimney shell surfaces and painting/coating of all structural steel work and miscellaneous ferrous components (for a maintenance free life of at least ten years), all finishing works, electrical power, distribution boards, lighting panels, power and control cabling and wiring systems, cable conduits. stair and platform lighting, socket outlets, lightning protection and grounding system, aviation obstruction lighting, communication system and a rack and pinion elevator. The chimney shall have a suitable

foundation. Lightning protection and aviation obstruction lighting shall be provided during construction phase also.

1.04.00 **ROADS & DRAINS**

Single Lane Roads

All access roads to all buildings/facilities/structures shall be single lane roads 6.75m wide with 3.75m wide bituminous pavement and 1.5m wide shoulders on both sides of roads.

Drains

Drains shall be constructed on both sides of double lane and single lane roads. All drains shall be connected to the trunk drain suitably, which finally gets connected to the drains outside plant boundary. All drains shall be of RCC with rectangular section.

CHAPTER-7

ELECTRICAL SYSTEM

1.00.00 This section shall cover aspects of Electrical Power Supply requirement for proposed FGD System including Auxiliary Power Supply system, Emergency Power Supply system, DC Power Supply system and associated Transformers, Switchgears, cables, cabling, relaying & protection, control & monitoring system and associated electrical system/equipment.

2.00.00 **POWER SUPPLY SYSTEM**

2.01.00 **STAGE-I, 2X600MW**

The Singareni Thermal Power Plant, Jaipur of SCCL, Telangana units of Stage-I consist of 2X600MW (unit # 1&2). The unit # 1 & 2 consist of two numbers STG of 600MW rating and the Generation voltage is 21 kV. The Generators are connected to the 400 kV Switchyard through 3X1-phase, 260MVA, 21/420 kV Step-up Generator Transformer and evacuated through 4 (four) numbers transmission lines (400KV), 2 (Two) numbers 132kV transmission lines emanating from the power station. An ICT of rating 100MVA, 400 kV/132 kV/ 33 kV (YNa0d11) is used to transmission of power through 132 kV transmission lines. The start-up power is being derived from 400kV switchyard through two (2) nos. 100/50/50 MVA, 400/11.5 kV Station Transformers (ST#1&2). Each generator is connected to two (2) nos. 31.5MVA, 21/11.5 kV Unit Transformers (UT#1A&1B) to meet the unit auxiliary loads. Three voltage levels i.e. 11 kV, 3.3 kV & 0.415 kV are adopted for feeding the main plant and off-site auxiliaries. The designed fault levels for 11 KV & 3.3 KV systems shall be restricted to 40 kA rms for 1 second and 45 kA rms for 1 second for 415 V systems.

2.02.00 **FUTURE EXPANSION**

Power supply source 1 & 2 for all the common system of FGD has been considered from the existing units station boards, however in case of the expansion of the existing units, the 2nd source shall be shifted to new expansion units Station Boards suitability.

3.00.00 **POWER REQUIREMENT AND SOURCING OF POWER FOR FGD**

The FGDs are to be installed for Unit # 1&2.

After considering the merits, a wet flue gas desulphurization (FGD) system is proposed for Stage-I consist of 2X600MW of Singareni Thermal Power plant. The proposed FGD system mainly consists of following systems/sub system: -

- Absorption system.
- Lime stone preparation system.
- Primary gypsum dewatering system.
- Gypsum dewatering system.
- Process water system.
- Flue gas duct booster fans and dampers.
- Lime stone handling system.
- Gypsum handling system.
- Primary gypsum dewatering system/Gypsum dewatering system.
- Auxiliary storage system.
- Process water system.
- Hoisting system/ others miscellaneous system.

The uninterrupted electrical power requirement can be met through three voltage levels i.e. 11 kV. 3.3kV & 0.415 kV which are already adopted in the existing system of Stage-I for feeding power to the plant auxiliaries.

The total connected load expected for proposed FGD system will be around 15.0-18.0MW for 600 MW unit. However, the maximum running loads will be around 9.0 – 12.0MW for 600 MW unit. The total connected load requirement for Singareni TPP (2X600MW) will be around 36 MW. The electrical system shall be design for proposed FGD loads. The auxiliary power consumption for introduction of FGD would contribute around 1.2%–1.5%.

The load requirement has been considered based on the running of wet Flue Gas Desulphurization (FGD) system. There may be a minor variation of loads as indicated in the above para for 600 MW unit based on the manufacturers design.

The following power supply source has been identified as the best available option to meet the FGD power requirements.

Power Supply

To tap power from 11 kV Station Auxiliary Boards, 11kV Unit Auxiliary boards of Unit # 1&2 by utilizing existing spare feeders as a main supply. Spare feeders available in Unit boards shall be utilized for feeding the power supply to Booster fan motors. Spare feeders available in Station boards shall be utilized to meet the remaining power. 2 Nos of 11KV/3.45KV transformers of adequate rating shall be used to feed the 3.3KV loads of respective units.

Power supply source 1 & 2 for all the common system of FGD of Stage-I&II has been considered from Stage-I, however after commissioning of Stage-II, the 2nd source shall be shifted to Stage-II Station Boards suitability.

Accordingly, scheme for sourcing of power FGD has been developed. Detail scheme is attached as **EXHIBIT- E1**.

4.00.00 **RETROFITTING / REPLACEMENT OF 11 kV BOARDS WORK**

a) The nominal current rating of existing BHEL make (VM12) outgoing feeders of 11 kV Station Auxiliary Boards of Unit # 1&2 is 630A, which needs to be upgraded to meet the power requirement of FGD. Scope shall include replacement / retrofitting of 2 (four) numbers 11 kV feeders identified for FGD with 1250 A CBs including associated items.

b) Scope shall also include necessary modification to be done in the existing transformer feeders in the Unit boards into motor feeders for utilizing them as Booster fan motor feeders including change of relays.

c) Energy meters shall be provided in all above feeders (2 Nos. of feeders in the existing Station board from where FGD power other than booster fan shall be tapped and Booster fan Motor feeders in Unit board) for energy accounting purpose. The energy meters shall be microprocessor based. MWH meters having an accuracy class of 0.2 or better. The energy meters supplied under this package shall be integrated with existing metering master station in control room.

5.00.00 **PROPOSED SYSTEM / EQUIPMENT REQUIREMENT**

The following system is proposed for design, engineering, manufacture, Type testing and inspection at manufacturer's works, packing, supply, transportation, transit insurance, delivery to site including custom clearance/port clearance (if required), receipt & unloading, handling & storage, in plant transportation, erection including associated civil, structural and architectural works, Testing & commissioning of the complete equipment/ system and works of following: -

- 11/3.45 kV FGD Transformers
- 11/0.433 kV FGD Auxiliary transformers
- HT Switchgears
- LT Switchgears
- HT&LT Drives/Motors
- DC system – Battery and Battery Charger
- Cables, Cabling, Earthing, Lightning Protection etc.
- Indoor & outdoor Lighting etc.
- Control & Protection system
- VFD
- DG Set
- Other Associated electrical system

(Bill of Quantity for electrical system is attached at end of this chapter)

6.00.00 **PROPOSED SYSTEM / EQUIPMENT DESCRIPTION**

General Philosophy of Electrical System Design, Short Circuit Levels and Withstand Duration, Sizing criterion of equipment, Auxiliary Power Supply Schemes, MV & LT System, AC & DC Emergency Power Supply System, Technical Features and Parameters of Electrical System to be Provided for proposed FGD system are described in brief for the purpose of detailed project report (DPR) are as under: -

6.01.00 **GENERAL**

a) The proposed typical scheme shall be as per the Exhibit-E1 Titled "Single line diagram for FGD Auxiliary Power Distribution"
b) For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered.
c) The equipment shall operate in a highly polluted environment.
d) All equipment shall be suitable for rated frequency of 50Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency.

6.02.00 **EQUIPMENT LAYOUT CRITERIA**

1. The following clearances to be maintained for control panels/cabinets:

   a) Inter panel spacing - 1200mm

   b) Clearance from back - 1000mm

   c) Clearance from front - 1000mm

   d) Clearance from side wall - 1000mm

   The above clearances are minimum requirement and may increase with increase in door swing of the cabinets.

2. The cable vault space below the HT / LT switchgear room and Control Room shall have 800 mm wide and 2.1m high movement passage all around the cable trays in the cable vault / cable spreader room for easy laying/maintenance of cables.

3. Adequate distance shall be maintained between the transformers. As basic guidelines following norms will be adhered to:

   a) Power transformers shall be separated from the adjacent building /structures and from each other by a minimum distance as defined below or by a fire wall of two hours of fire resisting of height at least 600 mm above bushing / pressure relief vent whichever is higher.

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

   In case of auxiliary transformers having an aggregate oil capacity in excess of 2000 liters, the minimum separating distance between transformers and surrounding building shall be at least 6M unless they are separated by fire separating walls. For transformers rated above 10 MVA or transformers having an aggregate oil capacity in excess of 2000 liters, high velocity water spray system or nitrogen-based injection system shall be employed.

4. Layout requirements for Electrical MCC/switchgear rooms. The following clearances shall be maintained for HT Switchboard.

   a. Front Clearance

      i) For one Row of Swgr. - 2.0M (Min)

ii) For two Rows of Swgr. - 2.5M (Min)
iii) Back Clearance - 1.5M (Min.)

b. Side Clearance

Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore, end clearance shall be 800+width of panel. Minimum clear working space - 1200mm (Around the equipment)

The following clearances shall be maintained for LT Switchboard.

a.) Front Clearance

i) For one Row of Swgr - 1.5M (Min)

ii) For two Rows of Swgr - 1.5/1.75M depending upon room size

b.) Back Clearance

i) For single front - 1.0M (Min)
ii) For double front - 1.5M (Min)

c.) Side Clearance

Min. 800 mm, however provision to be made for any additional panel in future at both ends. Therefore, end clearance shall be 800 mm + width of panel. HT Switchboard clearances shall be followed wherever both LT & HT switch boards are in the same MCC room.

Height of HT/LT Switchgear Room

i) With Bus Duct – 4.5 m (min)
ii) Without Bus Duct – 4.0 m (min)

6.03.00 **SHORT CIRCUIT LEVELS AND WITHSTAND DURATION**

The system fault level even during unusual modes of operation must not exceed the switchgear fault handling capabilities. The maximum fault levels at various voltage levels shall be limited to following:

1) 11 kV: 40 kA breaking with 100 kA (peak) making
2) 3.3 kV: 40 kA breaking with 100 kA (peak) making
3) 0.415 kV: 45 kA breaking with 105 kA (peak) making.
4) For the calculation of fault levels, the short circuit levels of 400 kV EHV systems shall be considered as 50 kA.

5) The different equipment shall be sized for the following through fault withstand capabilities:

- Aux. transformers (11/0.433 kV, 11/3.45 kV): 2 seconds
- 11 kV bus duct : 1 second
- 3.3 kV bus duct : 1 second
- Cables to the feeders protected by breakers - Main protection fault clearing time with 0.12 seconds minimum
- Cables for all other feeders - As per the fault clearing time of fuses.
- 11 kV / 3.3 kV cables sheath 2 seconds for adopted ground fault current
- The switchgear, motor control centers and distribution boards shall have positive, fool-proof interlocking to ensure that different supplies and transformers are not operated in parallel and fault level does not exceed the switchgear capability except during momentary paralleling in case of on-load changeover.
- DCDB 20 KA for 1 second

6.04.00 **H.T. SWITCHGEAR**

Switchgears shall be indoor, metal clad draw out type with Vacuum Breakers. Contractors cum fuse units may be used for auxiliaries such as conveyors/crushers motors, which require comparatively frequent switching. The switchgears shall have Communicable Numerical Relay for protection, control, metering and monitoring of the Switchgears. All the relays shall be networked to a dedicated HMI through data concentrator for Monitoring and Supervision of all the breaker panels.

MV switchgears shall be of 11 kV and 3.3 kV Voltage levels. The Switchgears shall be Indoor, Metal clad, single front and fully compartmentalized, with degree of protection IP42 for breaker/contactor compartment and IP52 for metering/relay compartments.

All busbars shall be color coded. All busbars shall be provided with non-halogen based heat shrinkable polymer sleeves having excellent performance in high voltage environments and reduces the noxious and corrosive effects in fire situations. Busbar sleeves shall be of tested design as per relevant IEC/ASTM/equivalent standard.

The designed fault level for 11 kV, 3.3 kV system shall be restricted to 40 KA (rms) for 1 Sec. The Switchgears shall have an Internal Arc Classification of IAC FLR 40kA, 1

sec. Surge arresters are provided for all motor feeders to limit the switching over voltages (unipolar). Suitable Interlocks are provided to ensure that Breaker is off before opening the back doors.

Circuit Breakers shall be Vacuum type. They comprise of three separate identical single pole interrupting units operated through a common shaft by a sturdy mechanism. Outgoing Breakers are suitable for Switching transformers and motors at any load and shall be suitable for frequent direct-on-line starting of squirrel cage induction motors.

The high voltage contactors shall be of AC-3 utilization category and shall be vacuum type. The fuse and overload relay shall be fully coordinated, so that the contactor operate only for a fault current less than its interrupting capability. The fuses shall have mechanical trip indication. Surge suppressors shall be provided on all contactor controlled motor feeders.

Protection and Controls: For protection, control, metering & diagnostics Communicable Numerical relays shall be provided for automation of MV Switchgears. The various Breakers that shall be automated are:

- 11 kV/3.3 kV Incomers
- Outgoing MV/LV Transformers Breakers
- Tie Breakers
- Bus Couplers
- Bus Transfers & Synchronization
- LT Incomers
- LT Tie Feeders
- LT Bus Couplers
- LT Outgoing Feeders (Breaker Controlled)

a) For various feeders including motor feeder numerical relays (Protection units) are proposed and these units shall communicate remotely to PLC/DDCMIS. For Motor feeders process interlocks/logics are developed in PLC/DDCMIS only.

b) The numerical relays proposed shall be of latest version and shall have integrated protection features of all type of protections, control. and metering, self-diagnosis, MIS for remote locations and interface with MMI.

c) There are technical and economical, operational and maintenance advantages of the proposed automation system with Numerical relays. Technically the system offers more functionality (with respect to both protections as well as Control), self-diagnostic checks, reliability, trending and monitoring, ease of operation and more flexible engineering. Economically the system will reduce extensive cabling, reduced cost of maintenance and operations and less down times. The number of CTs/ VTs and their VA burden will also be reduced. The adoption of numerical relays may also reduce the overall height of the Switchgears.

d) Standard IEC 61850 is proposed for communications as it shall allow making HMI an independent subsystem connected to the automation structure through a standard communication interface. IEC 61850 shall take care of multi-vendor IEDs.

Numerical relays with communicable features shall be procured with the following applications:

e) Protection, metering and control schematics, presently being hard wired within individual breaker panel shall be configured at relay level utilizing control and communication features of the relays.

f) All the relays shall be networked to a dedicated switchgear SCADA HMI through data concentrator for Monitoring and supervision of all the breaker panels. All such data flow shall be linked to DDCMIS as well through switchgear SCADA System. The circuit breaker will normally be controlled from remote control panels (DDCMIS) through closing and shunt trip coils. However, for motor feeders, process interlocks/logics are developed in DDCMIS only.

g) Breaker and relay contacts shall be hard wired to DDCMIS for building board wise logics as being done presently.

6.05.00 **BUSDUCT**

The busduct will have on all aluminium construction. The busduct shall be natural air cooled. The degree of protection shall be IP-55. Segregated phase bus ducts are envisaged for connecting between MV service transformer and 3.3 kV Switchgear. Non-segregated phase bus ducts are envisaged for connecting between LV service Transformer and 415 V PCC/MCC If Transformer Rating is 1000 kVA and above.

6.06.00 **FGD TRANSFORMERS / AUXILIARY TRANSFORMERS**

FGD Main Transformers and Auxiliary Transformers shall be as per Electrical Single Line Diagram FGD System Drg attached as Exhibit-E1 and as per system requirement under most onerous conditions, with the criteria that each 415 V switchgear / MCC / DB shall be fed by 2x100% or 3 X 50 % transformers / feeders, and these shall be rated to carry the maximum load expected to be imposed.

All Auxiliary transformers (11/0.433 kV, 11/3.45 kV) shall be sized so as to have 10% margin at design ambient conditions after considering final load requirements at peak load conditions and the No Load Voltage Correction Factor.

All these transformers will be delta connected on the HT side and star connected on the LT/MV side. The LT (0.433 kV side) star point will be solidly earthed. The MV (3.45 kV side) star point will be earthed through resistance to limit the ground fault current to 300A. These transformers shall be mineral oil filled for outdoor installation, dry type transformer forced cooling with temperature controller for indoor installations.

No Load Voltage Correction Factor (=Transformer No Load voltage/ rated bus Voltage) shall be used for sizing of all transformers i.e.

The transformer size = the calculated size X no load voltage correction factor

Rating of the transformers shown in the SLD are indicative.

6.07.00 **MOTORS**

All motors are required to have a voltage within permissible limits both during starting and during normal running. In line with 500MW unit size practice, the standard three voltage level scheme i.e. 11 kV, 3.3 kV & 415V system has been adopted. All equipment's shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency

i) Auxiliary power system shall be designed in such a way that, voltage variation at different voltage levels do not exceed the limits given below under worst operating conditions at equipment terminal.

ii) HT and LT Motors shall be designed to operate in this specified voltage variation:

Motor rating		Voltage drop (Under normal Running)	Starting Voltage requirement (Min) at motor terminal
Below 110 KW		10%	85%
Above110 KW to 200 KW		10%	80 %
201 KW to 1000 KW		6%	85%
1001 KW to 4000 KW		6%	80%
Above 4000 KW		6%	75%

Further as motor driving the essential and vital station and unit auxiliaries on which operational reliability of power plant depends, shall run continuously at rated output with voltage variation as described above.

Motors shall not stall due to voltage dips in the system causing momentary drop in voltage to 70% of the rated value for a duration of 2 seconds. Motors shall withstand the application of 150% of the rated voltage for at least 1 second caused due to vector difference between the residual voltage and incoming supply voltage during changeover of buses. The motors shall be capable of withstanding the inrush current caused by such bus transfer without damage.

The voltage level for motors shall be as follows:

a) Up to 0.2 KW : Single phase 240V AC / 3 phase, 415V AC
b) Above 0.2 KW and up to 200 KW : 3 phase, 415V AC
c) Above 200 KW and up to 1500 KW : 3 phase, 3.3 kV AC
d) Above 1500 KW : 11 kV

Motors shall have IP-54 degree of protection for Indoor motors location and IP-55 for Outdoor location. The All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. TETV/ CACA type shall be provided with shaft mounted fans only. However, Motors rated 3000KW or above can be closed air circuit water cooled (CACW). Motors and EPB located in hazardous areas shall have flame proof enclosures

All HT Motors shall have thermal insulation class 'F' and 240 Volts AC, 415 V AC and 220 V DC motors shall be thermal class B or better with temperature rise limited to 70

Deg. C by resistance method. Suitable single phase space heater shall be provided for all LT motors of rating above 30 kW and all HT motors. Motors of rating 110 kW and up to 200 kW shall be controlled from LT switchgear through Air Circuit Breaker.

Motors and EPB located in hazardous areas shall have flame proof enclosures. The continuous duty LT motors up to 200 KW Output rating (at 50 deg. C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS:12615, or IEC:60034-30. The Crane duty motors shall be slip ring/ squirrel cage Induction motor. The DC Motors shall be Shunt wound.

6.08.00 **415 VOLT LT SWITCHGEAR**

The LT transformers shall feed power to the 415V switchgears, which in-turn would distribute power to various MCC's located at load centers. The 415V system will have duplicate incomer and bus coupling arrangements so that a changeover can be made from either of the two step down transformers to restore power in case of failure of one of the above two transformers. The 415 Volts switch boards shall be indoor, draw-out type compartmentalized with air break circuit breakers.

The LV switchgears shall have Communicable Numerical relay system for protection, Control, metering and monitoring of the Switchgears. All the relays shall be integrated with HT network for common HMI through data concentrator for Monitoring and Supervision of all the breaker panels. All such data shall be linked to DDCMIS as well. The inbuilt feature of numerical relays shall be used for energy accounting and audit meters as per notified metering regulations.

Key Design Features for LV switchgears

a) All 415V switch gear motor control centers (MCCs), AC & DC Distribution Boards (DB s), etc. shall be of metal enclosed, indoor, floor mounted and free standing type

b) LV Switchgears (circuit breaker) panels shall be fully draw out type single front and MCC shall be fully draw out type single/ double front and ACDB & DCDB shall be of fixed module type. Circuit Breakers shall be of air break, three pole, spring charged, horizontal draw out type, suitable for electrical operation. All switchboards, MCCs and DB s shall have distinct vertical sections for bus bars, circuit breaker housing, cable alley and relays. Cable terminations located in cable alley shall be designed to meet the Form IVb Type 7 (as per IEC 60439) for safety purpose.

c) The cross-section of the bus bars shall be uniform throughout the length of switchboard and both horizontal as well as vertical bus bars shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents. The bus bars for switchboards with a rating of more than 1600A shall have an interleaving arrangement.

d) The entire bus-bar system of all switchgears, MCCs, ACDBs, DCDBs and fuse boards shall be PVC sleeve insulated.

6.09.00 **CRITERIA FOR AUXILIARY POWER SUPPLY ARRANGEMENT**

The auxiliary power supply system must form a reliable source of power for FGD auxiliaries The requirements to be met by the auxiliary system are as follows: -

a) The auxiliary power supply system shall be designed with suitable margin to enable the satisfactory operation of the system with voltage and frequency limits as defined.

b) The overall system shall be such that failure of any piece of equipment has the minimum possible effect on the plant's capability. In particular failure of a transformer, section of LT or HT switchgear, DC battery or charger shall not reduce the plant's capability or affect the safe shut down requirements of the plant.

c) The loads for mechanical auxiliary systems i.e. material handling, water systems etc. shall be met by auxiliary transformers based on the criteria that each switchgear/MCC/Distribution board shall be fed either by 2xl00% or 3x50% transformers/feeders and, these shall be rated to carry the maximum load expected to be imposed. Each of the above boards shall be sectionalized.

d) As far as practicable the system shall provide segregated supplies to main and standby auxiliaries so that failure of supply to main auxiliary shall in no way jeopardize the standby auxiliary feed. Automatic changeover at critical switchgear/ MCC sections shall be provided as necessary to prevent the loss of a unit or to ensure the equipment safety.

e) The switchgear, motor control centers and distribution boards shall have positive, fool-proof interlocking to ensure that different supplies and transformers are not operated in parallel and fault level does not exceed the switchgear capability except during momentary paralleling in case of on-load changeover.

f) All equipment such as switchgear & all transformers shall be sized so as to have

10% margin at ambient temperature 40 deg C after considering final load requirements at peak conditions at corresponding ambient.

g) Transformer voltage ratios, taps, impedances and tolerances thereon shall be so optimized that the auxiliary system voltages under the various grid and loading conditions are always within permissible limits and the equipment are not subjected to unacceptable voltages during operation and starting of motors such as BFP etc.

6.10.00 **CHANGEOVER SCHEMES**

In the event of failure of normal source, provision shall be made to restore supply in order to provide better reliability for the system. Fast changeover scheme for 11 kV system, Manual/Auto changeover scheme for 3.3 kV and 415 V system shall be adopted. The control logic for the incomer and tie breakers are built in the electrical functional group of station (C&I) DCS. The manual change-over scheme is realized along with its control logic. The scheme enables manual closing of incomer/tie breaker after synchronization through synchro check relay permissive.

6.11.00 **DC SYSTEM**

FGD 220V DC system shall comprising of two nos. of Ni-Cad/ Lead Acid Plante batteries, and two nos. of float cum boost chargers to supply power to DC loads, emergency lighting, protection, annunciation, indications and control etc. The required level of redundancy would be achieved with the interconnections between these two batteries and chargers. Each of the unit batteries shall be sized for supplying the total DC load of the FGD for a period of 60 minutes under a complete black out condition.

Complete DC system, comprising of batteries, battery charges, relays, contactors, timers etc. shall be suitable for continuous operation at the maximum continuous float voltage including suitable temperature correction factors.

The battery sizing shall be done based on different types of continuous and intermittent loads including motor starting (wherever applicable) under complete blackout condition, for the duration specified so as to meet the system requirement. All intermittent loads shall be considered with minimum 1 minute duration. The battery shall be sized considering a minimum electrolyte temperature along with temperature correction factors as per relevant standard. An ageing factor of 1.25 shall be considered. The no. of cells, end cell voltage shall be considered based on the minimum and maximum voltage window and cable drop etc. as per system requirement.

Each system shall comprise of two nos. of batteries and two nos. of float-cum-boost chargers each rated for 100% capacity. DC scheme shall ensure that each critical consumer is fed from two different bus sections. DCDBs shall provide adequate number of feeders on each section.

Boost/ fast charging time shall be as per worst operating condition and would satisfy technical requirements recommended by battery manufacturer. Each battery charger must be capable of supplying all the continuous D.C. loads (fed through both section of DCDB) plus the trickle charging current of both the batteries. In addition, each charger must have sufficient surplus capacity for running of the largest D.C auxiliary so that the battery is not drained during testing of the same. Battery charger should also be capable of boost/ fast charge the battery from completely discharged condition to fully charged condition without imposing any limitations under worse operating conditions.

DC Health Monitoring Systems shall be provided to monitor the condition of each battery cell of 220V battery banks on-line on 24x7 basis. With DC Health Monitoring System, it shall be possible to measure & analyze the individual cell and battery parameters so that any damage to battery shall be prevented by pro-active maintenance.

6.12.00 **EMERGENCY POWER SUPPLY SYSTEM**

For the safe shutdown of the plant under emergency condition and in case of total power failure, diesel generating set shall be installed for feeding certain essential applications like battery chargers, emergency lighting, essential air conditioning/ventilation and all auxiliaries necessary for safe operation of plant (such as lime slurry tank agitators, oxidation agitators, Etc). The FGD emergency switchgear section shall be fed by one diesel generator of adequate capacity.

One no. Diesel Generator (DG) shall be provided as indicated in the single line diagram and sizing of DG set shall be to suit the emergency FGD loads.

DG set shall be 415 V, 1500 RPM and Engine BHP rating shall be Limited time running (LTP) rated Engine as per ISO 8528-1. DG set shall be provided with acoustic enclosure. DG set shall start automatically in case of power failure of AC power.

DG set including stack height, acoustics, air emission and fuel oil installation shall meet the requirement given by gazette notifications of Ministry of Environment & Forest time to time CPCB guidelines, all statutory requirement of Govt. of India and State Pollution Board Guidelines.

6.13.00 **PROTECTIVE RELAYING**

The necessary protective relaying system according to established norms shall be provided for HV switchyard transformers, motors, auxiliary system etc., to minimize damage to equipment in case of fault and abnormal conditions. The summary of protection details to be provided for the equipment is given below:

FGD TRANSFORMER

1. Back-up over current protection on HV and LV side (51T).
2. Restricted earth fault protection (64R) on HV & LV side.
3. Back-up earth fault protection on LV side (51 N).
4. Bucholz relay, winding temperature, oil temperature and oil level alarm and trip.
5. Fire protection to trip it's HV side breaker.
6. Local breaker back up (or breaker failure) protection for the breaker on HV side of transformer.
7. Over fluxing protection (99T).

6.14.00 **CABLES**

For HT cable, single core and three Core XLPE insulated cables with aluminium conductor would be employed. For 415 V and DC systems, single core XLPE insulated cables with aluminium conductor would generally be used for higher current ratings and multicore XLPE/PVC insulated cables with aluminium conductor would be used for lower ratings.

The cables shall be laid overhead/ in trenches or directly buried. Inter plant cabling for main routes shall be laid on overhead trestles/pipe racks.

HT cable shall be suitable for Un-Earthed (UE) system. All control cables would be multicore, PVC insulated with copper conductors. The cables shall be laid overhead/ in trenches or directly buried. Inter plant cabling for main routes shall be laid on overhead trestles/pipe racks. For HT cable, single core and three core Cross linked Poly Ethylene Insulation (XLPE) insulated cables with Aluminum conductor would be employed.

All the cables shall be armored type with Flame Retardant Low Smoke (FRLS) properties.

6.15.00 **FIRE PROOF CABLE SEALING SYSTEM**

In order to restrict the propagation of cable fire and spread of toxic smoke, the cable entry below control panels, cable penetration through walls, cables on the floors and cable entry above switchgears need to be sealed by fire seal system. Fire barriers shall also be provided to meet the segregation/ separation requirements.
The fire proof cable penetration seal system shall have minimum one hour fire resistance rating and shall fully comply with the requirement of BS:476 Part-8.
The fire seal system shall be completely gas & smoke tight, mechanically stable and shall retain their integrity and perform satisfactorily even after remaining in water for long period

6.16.00 **GROUNDING**

Buried grounding mats employing suitable dia. MS rods, shall be provided for HV switchyards, FGD area, pump house etc. for keeping the step and touch potential within safe limits. All the connections above the ground would be of galvanized steel.

The earthing system for plant and switchyard shall be designed for a life expectancy of at least forty (40) years, for a system fault current of 50 kA for 1.0 sec. The minimum rate of corrosion of steel for selection of earthing conductor shall be 0.12mm per year.
Grounding FGD plant, switchyard and other areas or buildings covered in the specification shall be provided in accordance with IS 3043, IS 2309, IEEE 80 and IEEE 665.

Interconnection of earthing grid of extended portion of FGD shall be connected with existing earth grid.

6.17.00 **LIGHTING SYSTEM**

Adequate lighting arrangement shall be made for the entire FGD plant employing lighting distribution boards, panels, LED Luminaires for the lighting of all the indoor & outdoor areas. However, for DC lighting, hazardous areas & aviation lighting etc. conventional type luminaries shall be used.

Normal lighting of the plant will operate with the station AC supply. About 20% of these fixtures will also have arrangement for being fed from diesel generators on failure of station AC supply. Emergency DC lighting, which will normally be off, would be provided for all strategic locations.

6.18.00 **CABLING**

Cable trays and their accessories with support arrangements, trestle, trenches, duct bank etc. as required for the cables for the complete system. This shall also include laying of cable from employer board as shown in Electrical Single Line Diagram attached as Exhibit-E1 on the employers' nearest trestle in the FGD area subject to availability of space and suitability. In case of non-availability of space in employer's trestle, necessary arrangements shall be included for cable tray erection & cable laying.

All accessories such as rigid/ flexible conduits, fittings, junction boxes, tying materials, cable tags, Straight-through jointing kits for HT XLPE power cable, LT power and control cables, Cable termination kits for HT XLPE power cables, Welding receptacles, Trefoil cable clamps, Junction boxes and markers etc. for the cables under this scope.

Fire proof cable penetration sealing system of Type-A and Type-B for cable galleries, cable exits etc.

6.19.00 **PAINTING FOR ELECTRICAL EQUIPMENT**

The painting of all electrical equipment shall be epoxy based with suitable additives. The thickness of finish coat shall be minimum 50 microns (minimum total DFT shall be 100 microns). However, in case electrostatic process of painting shall be for any electrical equipment, minimum paint thickness of 50 microns for finish coat.

6.20.00 **CONSTRUCTION POWER**

To meet the construction power requirement of the FGD and associated systems, the Employer shall provide two (2) nos. 415V feeders in LT switchgears. Further extension of power to meet the construction power requirements at the various locations through suitably rated Isolation Transformers along with LT distribution boards shall be provided as per requirement. LT Packaged Sub-stations with isolation transformers may also be used for this purpose. Suitable metering arrangement along with associated Instrument transformers and Metering Cubicles meeting the DISCOM requirements shall be provided at each Construction power feeder.

6.21.00 **VARIABLE FREQUENCY DRIVE (VFD)**

The VFD system shall be either Current Source Inverter (CSI) or Voltage Source Inverter (VSI) type. The system shall be suitable for linear continuous speed control for a range as per the requirement of driven equipment. The system shall meet the requirements of IEEE 519 for the harmonics generated at the input of VFD system and

	transferred to power supply bus as well as output to motor. All required protections like Overload, Earth fault, Overvoltage, Over-speed, Negative sequence, etc as required and applicable for the system shall be provided. All the circuit components shall be suitably protected against over voltages, surges, lightning etc. All the VFDs shall be of same design so as to ensure 100 % interchangeability of components. The VFD System shall be of IGBT based or latest technology. The VFD Motors shall be suitable for VFD application.
7.00.00	The auxiliary power supply for FGD system is to be sourced from 11kV existing system by utilizing the spare motor feeders of Unit switchgear boards (1A&1B for unit#1 and 2A&2B for unit #2) for booster fans and spare feeders of Station Transformer switchgear boards (OBA and OBD) shall be utilized for all common services loads of FGD system. The essential loads shall be met from separate DG set. To make the complete system, all electrical system like DC Power Supply system, power & auxiliary transformers, switchgears, cables, cabling, relaying & protection, control & monitoring system and associated electrical system/equipment shall be provided to feed interrupted power to meet the FGD loads.

CHAPTER-8
FGD SYSTEM - CONTROL & INSTRUMENTATION

1.00.00 GENERAL

The function of the Control & Instrumentation System would be to aid the operator in achieving safe and efficient operation of the unit, resulting in cost effective operation of system. The C&I system would be of the type which normally relieves the operator of continuous duties and would take pre-planned corrective actions in case of drift in process or if unsafe trends or conditions develop in any regime of operation viz. startup, shutdown, normal working and emergency conditions. The design of C&I system would be such as to permit on-line localization, isolation and rectification of fault in the minimum possible time.

2.00.00 CONTROL ROOM CONFIGURATION & LAYOUT

It is proposed to have air-conditioned Common Control Room for the FGD Systems at appropriate place near FGD system with OWS/EWS. The control system cabinets would be located in air-conditioned Room. UPS, 24V DC Modular Power Supply would be located in the air conditioned environment. Batteries for UPS & 24 V modular power supply shall be located near FGD Control Room in air-ventilated environment.

3.00.00 CONTROL & MONITORING PHILOSOPHY

Control Desk (UCD) for mounting monitors / Keyboards (KBDs) would be provided.

In line with recent practices, Remote operation with OWS as well as GIU based local operation facility shall also be provided depending on the layout of the control room.

For DDCMIS based standalone FGD control system link shall be provided for exchange of data in the main plant control room for the information of unit-in-charge/shift-in-charge etc. through Station Wide LAN.

4.00.00 MEASURING INSTRUMENTS (PRIMARY & SECONDARY)

Primary measuring instruments such as transmitters, sensors etc. for the measurement of parameters like pressure, temperature, level, flow & CEMS (Continuous Emission Monitoring System) analyzers with associated items (SO2/Nox/CO/CO2/O2/Hg-Mercury/particulate matters analyzers & Flue gas flow etc) would be used.

All instruments in slurry lines shall be provided with isolation valves and diaphragm. All temperature elements shall be provided with Temperature Transmitters. Only Ultrasonic Level Transmitters shall be provided for slurry tanks/sumps. All pumps manual suction valves shall be provided with open limit switch. All slurry tanks shall be provided with field indicators for local level indications and other tanks shall be provided with level gauges for local level indications.

5.00.00 **DISTRIBUTED DIGITAL CONTROL, MONITORING & INFORMATION SYSTEM (DDCMIS)**

As already indicated above, microprocessor based Distributed Digital Control Monitoring & Information System (DDCMIS) would be provided for the safe, reliable and efficient operation of complete FGD system including all other accessories in package.

It is proposed to use optimum number of Monitors for the purpose of control, information and alarm monitoring as mentioned above. Each of the screens would be 100% interchangeable (i.e. control or monitoring for any part of the plant can be performed from any screen) and would provide complete control, monitoring, supervisory and display functions for control system variables and control system status. Changes in system configuration, tuning constants and similar engineering and maintenance functions would be done from Engineer/Programmer console.

Adequate numbers of printers would be provided for logs, reports and alarms. In addition to this, historical data storage and retrieval system would be provided.

Alarm Annunciation System and Sequence of Events Recording System (SERS) will be envisaged to be performed in DDCMIS itself. It is envisaged to provide alarm analysis system for the project.

6.00.00 **POWER SUPPLY SYSTEM (UPS & DC SYSTEM)**

Uninterrupted Power Supply (UPS) system to feed AC load like FGD Human Machine Interface (HMI). The UPS for FGD C&I system would consist of 2X100% parallel redundant Chargers and Inverters with Input Isolation Transformers, 1X100% Ni-Cd Battery Bank for one (1) hour duty, Bypass Line Transformers & Voltage Stabilizer, Static switch, manual bypass switch, 2X100% ACDB and other necessary protective devices and accessories.

Independent 24V DC modular DC power supply systems with Ni-Cd batteries shall be provided for FGD independent control system. Each set of power supply system shall consist of 2 sets with each comprising of 1x100% chargers, 1x100% Nickel-Cadmium batteries for one-hour duty, 1x100% DC distribution board (DCDB) for powering the DC load requirement of Contractor's system.

Intelligent Battery health management system (BHMS) shall be provided for each system of 24VDC power supply system and UPS batteries.

7.00.00 **CONTROL VALVES, ACTUATORS & ACCESSORIES**

Control valves and dampers would be pneumatically operated in most of the applications. However, for few applications electric/hydraulic actuators would be employed. Microprocessor based positioners shall be provided for pneumatic control valves and dampers.

CLAUSE NO.	DESCRIPTION
8.00.00	**INSTRUMENTATION CABLES** All instrumentation cables including both prefabricated and non-prefabricated type would be with Fire Retardant Low Smoke (FRLS) type Poly Vinyl Chloride (PVC) overall sheath. Multi pair cables of 0.5 sq. mm. shall be used extensively for C&I cables, wherever required, pre-fabricated cables may also be used.
9.00.00	**INTERFACING OF FGD CONTROL SYSTEM WITH MAIN PLANT CONTROL SYSTEM** Hardwired Signal exchange: Hardwired signal exchange between main Plant Control system and FGD control system (to be located in FGD control room) like bypass damper status, inlet and outlet gates status, ID Fans status, ESPs status, Boiler Load Index (BLI), MFT etc. shall be envisaged on as required basis, for implementation of protections and interlocks. One Remote Input Output (RIO) per unit to be placed in Central Equipment Room (CER) for the same. IOs and cables for minimum number of hardwired signal exchange to be considered per unit as follows DI – 130, DO – 130, AI – 50 and AO – 50 (approximately). Same number of I/Os shall be provided in main plant control system by employer for hard wired signal exchange with FGD control system. 2 (Two) nos. of 24V DC power supply feeders per unit from existing charger to be considered by employer, for powering said RIO panel to be located in CER. Cabling from DCDB to RIO panel shall be done.
10.00.00	**DENOx CONTROL SYSTEM** To achieve NOx reduction, modification in Combustion system is proposed. Control for modified combustion system shall be done from employer's existing control system in main plant with some addition/modification in I/O cards to accommodate additional field instruments as per system requirements. Logic, alarms & HMI mimics shall also be modified accordingly in employer's control system. Change in SADC actuators, Instrument air piping, Burner tilt power cylinder, Filter regulators, flow elements, different instruments, cables, copper tubing, power supply etc. to be envisaged as per actual requirements during implementation.

CHAPTER-9

LAYOUT REQUIREMENT

FOR FLUE GAS DESULFURIZATION SYSTEM

FGD system generally comprises of absorber and related auxiliaries and its upstream systems like lime stone handling, limestone milling. FGD also has other downstream systems like waste treatment & disposal, Gypsum handling & disposal. All these systems require necessary space in and around flue gas downstream area. Following are the major equipment in FGD system

MAIN EQUIPMENTS IN FGD AREA

1. Isolation Dampers for FGD
2. Booster Fans
3. Ductwork, Expansion joints and Duct supports
4. Absorber tank
5. Absorber recirculation pumps
6. Oxidation air blowers
7. Waste water tank
8. Neutralization tank
9. Auxiliary storage tank
10. Unloading hopper
11. Vent Filter
12. Crushed Lime Stone Silos
13. Lime Stone Crusher House
14. Lime stone Slurry Tanks
15. Lime stone slurry pumps
16. Wet ball mill, mill recycle tank, mill recycle pump
17. Primary Hydrocyclone Classifier
18. Secondary Hydrocyclone classifier
19. Primary HC feed tank and pump
20. Secondary HC feed tank and pump
21. Belt filter wash pump
22. Mist Eliminator wash pump
23. Filtrate water tank
24. Vacuum Filter Tank
25. Vacuum Filter Pump
26. Makeup water tank (Process Water Tank)
27. Gypsum handling system
28. Gypsum storage area
29. ECW system

Area Requirement for FGD System

1.	Unloading Hopper	19.0x10.5M
2.	Transfer Tower	14.0x9.0M
3.	Lime Stone Crusher House	16.5x18.0M
4.	Crushed Lime Silo	13.5x13.5M
5.	Wet Belt Mill Area	25.5x22.0M
6.	Gypsum Storage Area	22.0x18.0M
7.	Bed Filter Area	21.0x15.5M
8.	Absorber Area(including reagent tank, make up water tank, pumps etc) for both units	135x105M
9.	MCC/Control Room	50x30.0M
10.	Booster Fan Area for one unit	65.0x40.0M
11.	Electric control Room, Switchgear	40x20 M

Layout drawing is prepared and attached with report for installation of FGD system Following drawings(tentative) has been also attached with the Report

S.no	Drawing No	Drawing layout
1	9972-999-POC-F-001	General Layout Plan
2	CONS-ENGG-9972-FGD-DPR-001	Layout plan of FGD system
3	CONS-ENGG-9972-FGD-DPR-002	Scheme of FGD absorber system
4	CONS-ENGG-9972-FGD-DPR-003	Scheme of FGD milling system
5	CONS-ENGG-9972-FGD-DPR-004	Scheme of Gypsum dewatering system
6	CONS-ENGG-9972-FGD-DPR-005	Scheme of limestone handling system
7	CONS-ENGG-9972-FGD-DPR-006	Scheme of Gypsum handing system
8	CONS-ENGG-9972-FGD-DPR-007	Scheme of ECW system
9	CONS-ENGG-9972-FGD-DPR-008	Electrical single line diagram for FGD auxiliary power distribution.

CHAPTER-10

LOW NOX BURNERS

1.00.00 SCCL Stage-I (2X600 MW) was commissioned in the year 2016 and units are under operation. The Boilers were originally designed for NOx level 260 gm/GJ (approx. 750 mg/Nm^3 and the measured value is almost near to the designed value. As per the Gazette notification dated 15.12.2015 the NOx level to be reduced to 300 mg/Nm^3. In order to reduce the NOx level Combustion Modification is to be undertaken in both units of SCCL Stage-I (2X600 MW).

2.00.00 Combustion modification to be carried out as a part of furnace modification, which would be required to reduce the NOx generation in combustion chamber. Combustion modification consists of replacing/modification the existing wind box by new redesigned wind box and installation of separator over fire air panel along with dampers. The objective of combustion modification is to reduce the NOx generated at required level during the combustion in boiler without effecting the designed boiler steam and flue gas parameters, FEGT, SH and RH Sprays, unburnt carbon, CO formation and slagging, water wall corrosion due to reduced air atmosphere at various loads, under various mills combination for the range of coals.

Major work involved in combustion modifications are :

Supply/ modification of Wind Box with Separate Over Fire Air (SOFA) panel : New/modified Re-designed Wind box including new coal, oil and air nozzle tips for all four corners, New Re-designed Tilting Tangential Burner Assembly, Burner Tilt Power cylinders, Modification in coal piping, coupling & its supports, Strengthening/modification of structure as required for carrying out combustion modification.

Major guarantees involved in combustion modifications are :

(i) **NOx emission :** The total NOx at the ID Fan outlet shall not exceed 300 mg/Nm^3 at 6% oxygen (O_2) content in flue gas on dry gas basis over entire range of steam generator operation from 40% to 100% TMCR load and for whole range of specified coal(s), with any mill combination, with min 20% excess air.

(ii) **Furnance Exit Gas Temperature (FEGT) :** The variation in FEGT along the cross section shall be within +/- 20 deg C before and after modification.

(iii) **Unburnt Carbon Loss :** The variation in unburnt carbon in corresponding to fly ash at ESP hoppers and Bottom ash shall be within +0.3% and 0.5% respectively before and after modification.

The salient Steam Generator design parameters at BMCR as per the original specification requirements are as follows:

Sl. no.	Description	100% BMCR
1.	Steam flow at superheater Outlet (T/hr)	1625
2.	Pressure at Superheater outlet kg/cm^2 (abs)	178
3.	Temperature at Superheater outlet (Deg C)	540
4.	Steam flow to Reheater (T/hr)	1354.2
5.	Steam Pressure at RH inlet Kg/cm^2 (abs)	44.89
6.	Steam temperature at RH inlet (Deg C)	336.3
7.	Steam Temperature at Reheater Outlet (Deg C)	568

CHAPTER -11

LIMESTONE SOURCES IN INDIA

Limestone is a sedimentary rock composed mainly of calcium carbonate ($CaCO_3$) in the form of the mineral calcite. The two most important constituents are calcite and dolomite. Limestone often contains magnesium carbonate, either as dolomite $CaMg(CO_3)_2$ or magnesite ($MgCO_3$) mixed with calcite.

- Limestone rocks are composed of either calcium carbonate, the double carbonate of calcium and magnesium, or mixture of both.
- Limestone also contains small quantities of silica, alumina, iron oxides, phosphorus and sulphur.
- Limestone deposits are of sedimentary origin and exist in all the geological sequences from Pre-Cambrian to recent rocks except in Gondwana.
- Over three-fourths of the total production of limestone of India is contributed by the states of Madhya Pradesh, Rajasthan, Andhra Pradesh, Gujarat, Chhattisgarh and Tamil Nadu.

Other calcareous material used by industry are 'limeshell', the thick calcareous shells of molluscs deposited in the form of beds as well as present in ancient lakes and shallow seas. "Marl", a lime rich mud which contains variable amounts of clays and silt.

A limestone rock which separates well along the stratification into a few centimetres thick slab is termed 'flagstone'. The dimensional limestone is used for building and ornamental stone.

1.00.00 RESOURCES

The total reserves/resources of limestone of all categories and grades as per NMI data based on UNFC system as on 1.4.2015 have been estimated at 203,224 million tonnes, of which 16,336 million tonnes (8%) are placed under reserves category and 1,86,889 million tonnes (92%) are under remaining resources category.

Karnataka is the leading state having 27% of the total resources followed by Andhra Pradesh and Rajasthan (12% each), Gujarat (10%), Meghalaya (9%), Telangana (8%), Chhattisgarh and Madhya Pradesh (5% each) and remaining 12% by other states. Grade wise, cement grade (Portland) has leading share of about 70% followed by unclassified grades (12%) and BF grade (7%). Remaining (11%) are different grades.

2.00.00 **LIMESTONE PRODUCTION**

The production of limestone in 2016-17 at 313.2 million tonnes increased by about 2% as compared to that of the previous year.

There were 771 reporting mines in 2016-17 as against 807 during the previous year. Twenty seven mines each producing more than 3 million tonnes per annum contributed 42% of the total production of limestone in 2016-17. The share of 15 mines each in the production range of 2 to 3 million tonnes was 11% of the total production.

24% of the total production was contributed by 54 mines each producing 1 to 2 million tonnes annually. The remaining 23% of the total production was reported by 673 mines and two associated mines during the year. Twenty five principal producers contributed about 77% of the total production. About 3.3% of the production was reported by public sector mines as against 4% in the previous year.

Rajasthan was the leading producing state accounting for (21%) of the total production of limestone, followed by Madhya Pradesh & Andhra Pradesh (11% each), Chhattisgarh & Karnataka (10% each), Gujarat, Tamil Nadu & Telangana (8% each), Maharashtra & Himachal Pradesh (4% each), and the remaining 5% was contributed by Meghalaya, Odisha, Uttar Pradesh, Assam, Jharkhand, Jammu & Kashmir, Kerala and Bihar.

3.00.00 **PRODUCTION OF LIMESTONE BY STATES**

Production of Limestone, 2014-15, 2015-16 to 2016 -17 (By States , focussed primarily on nearby states

Qty in MT; Value in m INR

States	2014-15		2105-16		2106-17	
	Quantity	Value (mINR)	Quantity	Value (mINR)	Quantity	Value (mINR)
India	**293273**	**5800**	**307001**	**6867**	**313196**	**6688**
Gujarat	26010	**404**	25622	**437**	24923	**433**
Himachal Pradesh	12710	**197**	12390	**218**	11009	**206**
Madhya Pradesh	39530	**702**	39430	**887**	35843	**642**

Rajasthan	61844	**1252**	67336	**1525**	67078	**1453**
Uttar Pradesh	2952	**53**	2596	**43**	2656	**41**
Rest Of India	150227	**3192**	159627	**3757**	171687	**3914**
Five proximity states	143046	**2608**	147374	**3110**	141509	**2775**

1. MADHYA PRADESH-CHHATTISGARH:

These two states produce about 27 per cent of the total limestone production in India. The extensive deposits occur in Jabalpur, Bilaspur, Damoh, Rewa and Satna districts. The other producing districts are Bastar, Betul, Raigarh, Durg.

2. RAJASTHAN:

Rajasthan, the third largest producer (14 per cent), has limited reserves of limestone. Here the cement grade limestone is obtained from Ajmer, Banswara, Dungarpur, Jodhpur, Kota, Sirohi, Tonk, Bundi, Alwar, Sawai Madhopur, Nagaur, Udaipur and Pali districts.

3. GUJARAT:

In Gujarat, good quality of limestone is produced in Banaskantha district. The other limestone producing districts are Amreli, Kachchh, Junagarh, Surat, Kheda, Panch Mahal and Sabarkantha districts. The state produces about 10 per cent of total production.

4.00.00 **IMPORTS OF LIME STONE**

In 2016-17 import of limestone was 17.8 million tonnes. Limestone was mainly imported from UAE (80.25%), Oman (12.44%), Malayasia (2.47%) ,Vietnam (1.79%) & Iran (1.76%). As per the foreign trade policy 2015-20, the import of limestone, lime kankar, lime shell and chalk are free. Imports of limestone increased to

17.18 million tonnes in 2015-16 from 13.94 million tonnes in the previous year. Imports of chalk in 2015-16 drastically decreased to 6,174 tonnes as against 26,734 tonnes in the previous year. Limestone was imported mainly from UAE (74%)

& Oman (17%), while chalk was imported mainly from Vietnam (96%) & France (2%) besides other countries.

Following table the indicates list for producer/supplier of limestone has been provided in. However, the employer shall take the expression of interest for supply of limestone for FGD system.

5.00.00 **INDEGENIOUS PRODUCERS OF LIMESTONE**

		Location of mine	
		State	**District**
1	Ultra Tech Cement Ltd, 'B' Wing,Ahura Centre, 2nd Floor, Mahakali Caves Road, Andheri (E), Mumbai-400 093, Maharashtra.	Andhra Pradesh	Kurnool
		Chhattisgarh	Raipur
		Gujarat	Amreli
		Karnataka	Gulbarga
		Madhya Pradesh	Neemuch
		Maharashtra	Chandrapur
		Rajasthan	Chittorgarh
			Jaipur
			Nagaur
		Tamil Nadu	Ariyalur
			Perambalur
2	Ambuja Cement Ltd, P.O. Ambujanagar, Tq : Kodinar, Junagadh–362 715,Gujarat.	Chhattisgarh	Raipur
		Gujarat	Junagadh
		Himachal Pradesh	Solan
		Maharashtra	Chandrapur
		Rajasthan	Pali
3	The ACC Ltd, Cement House, 121, Maharshi Karve Road, Mumbai – 400 020, Maharashtra.	Telangana	Adilabad
		Chhattisgarh	Durg
		Himachal Pradesh	Bilaspur
		Jharkhand	Singhbhum (W)
		Karnataka	Gulbarga
		Madhya Pradesh	Katni
		Maharashtra	Yavatmal
		Rajasthan	Bundi
		Tamil Nadu	Coimbatore
4	Jaiprakash Associates Ltd, Sector – 128, Noida – 201 304, Uttar Pradesh.	Gujarat	Kachchh
		Madhya Pradesh	Rewa
			Sidhi
		Himachal Pradesh	Solan
		Uttar Pradesh	Sonbhadra

5	Shree Cement Ltd, Bangur Nagar, Post Box No. 33, Beawar – 305 901, Rajasthan.	Rajasthan	Ajmer
			Pali
6	The India Cement Ltd, "Dhun Building" 4th Floor, 827,Anna Salai, Chennai – 600 002. Tamil Nadu.	Andhra Pradesh	Cuddapah
		Telangana	Nalgonda Ranga - Reddy
		Tamil Nadu	Ariyalur
			Perambalur
			Tirunelveli
			Thoothu- kudi
			Virudhu- nagar
7	Binani Cement Ltd, 37/2,Chinar Park, New Town,Rajarhat Dist - 24 Parganas North - 700157, West Bengal.	Rajasthan	Sirohi
8	Madras Cement Ltd, Ramamandiram, P.O.Rajapalayam–626117, Virudh Nagar, Tamil Nadu.	Andhra Pradesh	Krishna
		Karnataka	Chitradurga
		Tamil Nadu	Ariyalur
			Perambalur
			Thoothu- kudi
			Virudhu- nagar
9	Dalmia Cement Ltd, P. O. Dalmiapuram, Thiruchirapalli-621651, Tamil Nadu	Andhra Pradesh	Cuddapah
		Tamil Nadu	Ariyalur
			Perambalur
			Thiruchira- palli
10	Chettinad Cement Corp. Ltd, 6th Floor, Rani Seethai Hall Building, 603, Anna Salai, Chennai – 600 006, Tamil Nadu.	Tamil Nadu	Ariyalur
			Dindigul
			Karur
			Perambalur
11	J. K. Cement Works, Kamla Tower, Kanpur-208 001, Uttar Pradesh	Rajasthan	Chittorgarh
			Nagaur
		Karnataka	Bagalkot
12	Kesoram Industries Ltd, 9/1, R. N. Mukherjee Road, Kolkata – 700001.	Telangana	Karimnagar
		Karnataka	Gulbarga

13	J. K. Lakshmi Cement Ltd, P.O. Jaykaypuram, Sirohi, Rajasthan.	Rajasthan	Sirohi
14	Lafarge India Private Ltd, Crescenzo Building B-wing,10th Floor C-38,C-39,G-Block Bandra Kurla Complex, Bandra East, 229, Nariman Point, Mumbai-400 051.	Chhattisgarh	Janjgir- Champa, Raipur
15	Zuari Cement Ltd, Krishna Nagar, Yerraguntla-516311,Andhra Pradesh	Andhra Pradesh	Cuddapah
		Telangana	Nalgonda
16	A.P. Mineral Dev. Corpn. Ltd, 3rd Floor Rear Block, HMWSSB, Premises, Khairatabad, Hyderabad – 500004.	Telangana	Adilabad
17	Birla Corporation Ltd, Birla Building,9/1 R. N. Mukherjee Road, Kolkata – 700 001, West Bengal.	Madhya Pradesh	Satna
		Rajasthan	Chittorgarh
18	Bharathi Cements Corporation Pvt. Ltd, 8-2-626, Reliance Majestic, Road No.-10, Banjara Hills, Hyderabad – 500034.	Andhra Pradesh	Cuddapah
19	My Home Industries Ltd, 9th Floor, Block-3, My Home Hub, Madhapur, Hyderabad-500 081, Andhra Pradesh.	Telangana	Nalgonda
20	Century Textiles & Industries Ltd, Century Bhawan, Dr. Annie Besant Road, Mumbai– 400025, Maharashtra.	Chhattisgarh	Raipur
		Madhya Pradesh	Satna
		Maharashtra	Chandrapur
21	Sanghi Industries Ltd, P.O. Sanghipuram, Taluka- Abdasa Kachchh, Gujarat- 370511.	Gujarat	Kachchh

22	Prism Cement Ltd, 305, Laxmi Niwas, Apartments, Ameerpeth, Hyderabad-500016, Andhra Pradesh.	Andhra Pradesh	Kurnool
		Madhya Pradesh	Satna
23	Penna Cement Industries Ltd, Plot No.-705, Road No.-03, Banjara Hills, Hyderabad-500034, Andhra Pradesh.	Andhra Pradesh	Anantapur
24	OCL India Ltd, Rajgangpur Rajgangpur-770017, Odisha	Odisha	Sundergarh

CHAPTER -12
LIST OF PROBABLE VENDOR

1.00.00 Following are the list of probable vendor for installation of FGD

1. M/s Doosan Heavy Industries , South Korea
2. M/s Doosan Lentjes, Gmbh, Germany
3. M/s Mitsubishi Heavy Industries, Japan
4. M/s KC Cottrell, Korea,
5. Chiyoda, Japan
6. GE, Italy
7. GE, USA
8. Andritz, Austria
9. SEC-IHI Power Generation Environment Protection Engineering Co., Ltd., China
10. Babcox & Wilcox, USA
11. Kawasaki, Japan
12. IHL, Japan
13. M/s Doosan Power Systems India Pvt. Ltd.
14. M/s MHPS India Pvt. Ltd.
15. M/s BHEL
16. BGR Energy system Limited
17. Tata Projects Limited
18. ISGEC Heavy Engineering Limited
19. Thermax Limited
20. Indure
21. Punj Illyod
22. McNally Bharat Engineering Co. Ltd
23. Essar Project (India) Ltd.
24. Alstom India Ltd
25. KC Cottrell India Private Limited
26. M/s GE power india
27. M/s Reliance Infrastructure
28. M/s L&T

CHAPTER-13

1.00.00 **COST ESTIMATE FOR FLUE GAS DESULFURIZATION (FGD) SYSTEM**

FGD system shall be installed in the generating station to minimize SO_2 emissions in compliance with the conditions laid down by MOEF, GOI for the environmental clearances. The Estimated cost for installation of FGD in Singareni TPP (2 X 600 MW) will be approximately **64532.75 Lakhs.**

Basis of cost estimate with break up

Following table indicates the tentative break of total project cost.

S.No	Cost head	Value in Lakhs
1	Supply	30556.63
2	Spares	1527.83
3	Type Test charges	8.63
4	Freight & Insurance	1283.38
5	Civil	9136.34
6	Structural	540.92
7	Erection & commissioning	6111.33
8	Training	10.00
9	System Integration	23.39
9	**Sub total**	**49198.45**
10	GST	8855.72
11	**Work cost including GST**	**58054.17**
12	Contingency @3%	1741.63
13	IDC Including FC	4736.95
14	**Grand total**	**64532.75**

- For IDC Calculation interest rate has been considered as 9.46%.

2.00.00 **Auxiliary Power Consumption:**

The Auxiliary Power Consumption shall be approximately 14-18 MW, which will be 1.2-1.5 %.

3.00.00 **Landed price of limestone:**

The approximate landed price of limestone will be @ Rs 1200/MT to @ Rs 2000/MT (excluding taxes) including transportation Cost.

4.00.00 **Phasing of Expenditure:**

Estimated work cost including GST	58054.17
Contigency@3%	1741.63
IDC Including FC	4736.95
Total	**64532.75**

Fin. Year	Quarter	(%) Expenditure	Value in Lakhs
2019-20	Ist quarter	10%	6453.28
	IInd quarter	10%	6453.28
	IIIrd quarter	15%	9679.91
	IVth quarter	15%	9679.91
2020-21	Ist quarter	10%	6453.28
	IInd quarter	10%	6453.28
	IIIrd quarter	10%	6453.28
	IVth quarter	10%	6453.28
2021-22	Ist quarter	10%	6453.28
	IInd quarter	0%	-
	IIIrd quarter		

5.00.00 **Calculation for Impact on tariff**

Impact of tariff has been calculated on basis of following

1.	Generation (both units) (mu)@ 85% PLF	8935.20	mu
2.	Ex Bus generation assuming APC @ 6.75%	8332.07	mu
3.	Project cost including contingency	59795.80	Lakhs
4.	IDC including Financial charges (FC)	4736.95	Lakhs
5.	**Total project cost including contingency, IDC & financial charges**	**64532.75**	**Lakhs**
6.	Domestic borrowing (70%)	70*	%
7.	Equity	30*	%
8.	Interest rate	9.46*	%
9.	Return on equity (Post Tax)	15.50*	%
10.	Lime stone cost	1500	Rs/Ton
11.	Lime stone consumption@85% PLF for both units	24	T/hr
12.	Discount rate	9.86*	%
13.	Loan repayment period	12*	years
14.	Depreciation rate	5.15*	%
15.	O&M cost (% of project cost)	2	%
16.	Inflation Rate	12*	%

**Data furnished by SCCL*

Levelised tariff (Fixed cost)	**12.00**	**Paisa/unit**
Variable charges (first year)	**4.00**	**Paisa/unit**

Note:

i. The remaining plant life is considered for 25 years after FGD installation.
ii. 12 years of depreciation period is considered for FGD system.

Stage	Unit	Capacity	Date of commissioning
I	I	600 MW	25.09.2016
	II	600 MW	02.12.2016

6.00.00 **COST ESTIMATE FOR BURNER MODIFICATION FOR NOx CONTROL.**

The Estimated cost for installation of low NOx burner, providing over fire air in Singareni TPP (2 X 600 MW) will be approximately **2219.57 Lakhs**.

S.No.	Description	Amount in Lakhs
1.	Works cost including GST	2042.58
2.	Contingency	61.28
3.	IDC Including FC	115.71
	Total	**2219.57**

CHAPTER-14

Tentative Work Schedule for Flue Gas Desulphurization System Package

Sl.No.	Activity/Description of Milestones	Duration in months from NOA	
		Start	Finish
A	**Engineering Completion**		
1.	Engineering for start of civil work and BOI order finalization,	00	02
2.	Finalisation of engineering related to FGD inlet duct connection with ID-Chimney duct		04
2.	Complete engineering	-	08
B	**Manufacturing & Supply**		
3.	BOI Ordering		06
4.	Manufacturing & Supply of Equipments	-	18
5.	Manufacturing & Supply of gate, support structure, actuators etc. required for FGD inlet duct connection with ID-Chimney duct.	-	10
C	**Civil and Structural Works of FGD**		
6.	**Initial mobilization**	-	01
7.	**Civil & Structural Works:** Dismantling of existing structure (if applicable), Pilling, Civil & structural works for FGD system, Chimney, Limestone Handling System, Common Lime stone milling system, Absorber System, Gypsum Dewatering System Gypsum Handling System, Auxiliary Absorbent Tank, Process Water storage & Pumping System, Waste Water treatment system and associated cable trestles for air & water lines, slurry lines, steam line & waste water lines etc as per technical specification.	02	19
D	**Equipment Erection**		
8.	Equipment erection for FGD system, Limestone Grinding System, Absorber System, Gypsum Dewatering System, Auxiliary Absorbent Tank, Process Water storage & Pumping System, Waste Water treatment system etc. as per technical specification.	08	21
9.	**Electrical and C&I:** For FGD system, Limestone Handling System, Common Lime stone milling	-	24

	system, Absorber System, Gypsum Dewatering System, Gypsum Handling System, Auxiliary Absorbent Tank etc.		
E	**Commissioning of FGD**		
10	Commissioning	-	25
F	**Completion of facilities**		27

Note:

- The schedule given above is for Unit #1 and Common facilities. The activities specific to subsequent Units shall be phased at an interval of 3 months, except for engineering activities which shall be completed along with Unit #1

- Supply of mandatory spares needs to be ensured along with respective main equipment

TENTATIVE WORK SCHEDULE FOR LOW NOX BURNER MODIFICATION PACKAGE

Sl. No.	Activity/ Description of Milestones	Duration in months from NOA	
		Start	Finish
1.	Design, Engineering, Manufacturing	00	01
2.	Procurement of Raw materials & Manufacturing	01	05
3.	Supply & Receipt of material at Site	05	06
4	Dismantling	07	08
5	Erection	07	08
6	Commissioning, Testing & Completion of facilities	08	09

Note:

The above is for first unit. Completion of supply of material for first unit shall be 6 months with an interval of one month for consecutive units. Completion of facility for each unit shall be on availability of unit shut down.

CHAPTER-15
OPERATION AND MAINTENANCE PHILOSOPHY

1.00.00 **Operation and Maintenance Philosophy**

The details covered below are the general aspects of scope and other requirements to be carried out during operation and maintenance of FGD systems.

The brief O&M philosophy as indicated below. The details shall be further elaborated by the bidder in the O&M manual to be submitted to OWNER for approval. Items though not specifically mentioned but needed for continuous operation and maintenance of entire FGD plant to meet the intent of specification,:

(a) Ensuring successful operation of FGD Plant in three shifts for required SO2 reduction efficiency with optimum energy and Limestone consumption and producing good quality of gypsum.

Further, maintenance of the entire FGD plant by appointing experienced service engineers, supervisors, operators and technicians round the clock .

(b) Carrying out necessary Preventive maintenance and Breakdown maintenance, overhauls, furnishing technical assistance from experts & arranging visit of O&M experts to site from time to for ensuring smooth operation and maintenance of the plant. Also carrying out maintenance during annual overhauling /capital overhaul of the unit

(c) It has to ensure that FGD plant is operated and maintained as per "Operation and Maintenance instruction manuals" and in accordance with Engineer-in charge for coordination with operation/maintenance of main plant. Daily work of the operators involves logging the all the important parameters as required and running of the FGD plant in most efficient manner.

(d) The O&M personnel shall record monthly energy output of each array and transformer and reports shall be prepared on performance of FGD plant.

(e) Submission of periodical reports on the operating conditions of the FGD plant. It has to ensure that adequate measures are initiated in advance to overcome any actual or likely shortfall in performance

(f) Monitoring, controlling, troubleshooting, maintaining of records, registers.

(g) It has to maintain all spares and including critical spares in case of any major breakdown/annual overhaul and consumables required for atleast period of five years based on OEM experience.

(h) All actions to be taken to prevent pollution due to flue gas from duct /slurry leakage from pipeline during operation of the FGD plant. It shall be the responsibility to ensure minimum wastage of water.

(i) The maintenance shall include all repair/replacement of lime handling and milling system, absorber tank, gypsum handling system, cleaning/repair/rectification of nozzles of absorber and mist eliminator, repair/replacement of all cladding/lining inside absorber and chimney lining, maintenance of all valves, pumps, blowers, agitators, nozzles in flushing and filling lines, repair/replacement /fabrication of connected water/slurry lines & bends of FGD system & all other equipment etc. Further, preventive, routine and annual overhauling/breakdown maintenance related to all electrical and C&I works is also included.

(j) The Owner shall provide all amenities to workmen as per applicable laws and rules.

(k) All interlocks/protections shall always be in place and no bypassing shall be done.

(l) It shall ensure that all safety measures are taken at the site to avoid accidents .

(m) It has to take Comprehensive Annual Maintenance Contract (AMC) from Original Equipment Manufacturer (OEM) or OEM authorized service provider for Booster fans, Wet Ball Mills, Oxidation blowers, Vacuum filters, Slurry Recirculation pumps, Agitators, Slurry pumps Mist eliminators, Motors etc and any other equipment deemed necessary.

(n) Operation and maintenance of entire FGD plant to be managed in such a way to ensure that no power generation loss occurs.

2.00.00 **Training of O&M Personnel**

Considerable importance has to be given to training of O&M personnel so that the required skills in various specialized disciplines could be created in the shortest possible time. It is therefore very important to ensure that training is imparted to all engineers meant for operation and maintenance of the FGD so that it could become fully familiar with their area of work. This will be achieved by:

a) Study of O&M Manuals and Drawings.

b) Review / Preparation and finalization of commissioning documents.

c) Supervision of pre-commissioning and commissioning activity.

d) Preparation of documents for maintenance management system.

e) Training at manufacturer's works in specialized areas/simulator/other utilities.

This on-the-job training activity will be coordinated by Head (O&M) and Project Coordinator. Training in the areas of operation and maintenance of modern facilities shall also be organized.

2.01.00 **Training of Operation Engineers**

a) Training at manufacturers Works and other Utilities

The operation engineers will undergo extensive training at manufacturers work for familiarization and for design/testing aspects. They will also be imparted training in the running units of other utilities also where new technologies have already been adopted by these.

2.02.00 **Training of Maintenance Engineers**

Maintenance engineers will undergo extensive training at stations of other utilities. They will also be imparted training at manufacturers work for familiarization and for design/testing aspects.

CHAPTER-16
BILL OF QUNATITIES (TENTATIVE)

SL.NO.	DESCRIPTION	QUANTITY	UNIT	TECH. PARAMETRS
1.00.00	**PRELIMINARY & CIVIL WORKS**			
1.01.00	**Site Clearance**			
(i)	Site Clearance & Site grading	75000	M^2	
1.02.00	**Concrete Road and Drains**			
(i)	Single Lane Cement Concrete Road (Inside Plant)	0.75	KM	
(ii)	Rectangular Concrete Catch Drains	1.5	KM	
1.03.00	**Structural Steel (Supply, Fabrication and Erection)**			
	Conveyor Galleries, TP's, Crusher House, Pipe & Cable racks, Lime storage Shed, Gypsum storage Shed etc.	4500	MT	
1.04.00	**Foundation** All major Foundations like Absorber Tower, Chimney, Absorbent storage tank, Crusher House, Mills, Fans & other Machine Foundations, Silo foundations, Conveyor Gallery, TPs, Pipe & Cable racks, etc.	LOT		
1.05.00	**General Civil works** Civil and architectural works in FGD area comprising of Gypsum dewatering building, Ball Mill Building, Control room building, MCC building, Tank foundations, Storage sheds, etc.	LOT		
1.06.00	**Chimney** 200 Mts., twin flue RCC chimney with cladding of Titanium/C-276 alloy/ Borosilicate Glass Block on mild steel liner, with staircase and elevator (Rack & Pinion Type).	1	No.	

CLAUSE NO.	DESCRIPTION			
2.00.00	**MECHANICAL WORKS**			
2.01.00	**FGD SYSTEM**			
2.01.01	**Flue Gas System (2X600MW)**			
1	Booster Fan/FGD Inlet Gate	4	No.	2W/Unit. Motorised
2	Seal Air Fan for Inlet Gate	8	No.	(1W+1S)/Unit
3	Booster Fan	4	No.	2W/Unit. Axial type, constant speed, variable pitch with drive motor
4	Lub. system for Booster Fan	4	No.	1W/Booster Fan
5	Booster Fan Outlet Gate	4	No.	2W/Unit. Motorised
6	Seal Air Fan for Outlet Gate	8	No.	(1W+1S)/Unit
7	Bypass Damper	2	No.	1 damper each for Unit 1&2
8	Seal Air Fan for Bypass Damper	4	No.	(1W+1S)/Bypass damper
9	Flue Gas Duct System	Lot		From chimney inlet duct to FGD absorber system further to wet chimney
10	Duct Expansion Joints	Lot		
11	Insulation & Cladding for ducts	Lot		
2.02.00	**Absorber System**			
1	Absorber Tower with integrated tank at bottom	2	No.	1W/Unit. Absorber tower with integrated tank at bottom with spray banks and three stage mist

CLAUSE NO.	DESCRIPTION			
				eliminator
2	Slurry Recirculation Pumps	6	No.	3X50% (for single spray level)/Absorber
		4/per spray level	No.	2X100% (for multi level spray)/absorber
3	Oxidation Blowers	4	No.	(1W+1S)/Unit
4	Internal piping for oxidation air injection	Lot		
5	Absorber Agitators	10	No.	(4W+1S)/Unit
6	Emergency Water tank	2	No.	1W/Absorber
7	Gypsum Bleed Pumps	4	No.	(1W+1S)/Unit
8	Mist Eliminator Wash Pumps	4	No.	(1W+1S)/Unit
9	Absorber Area Sump	2	No	1W/Absorber Area
10	Absorber Area Sump Pump	4	No	(1W+1S)/Unit
11	Auxiliary Absorbent Tank	1	No	1W/Station. Tank complete with all agitators, piping, valves, fittings etc.
12	Auxiliary Absorbent Slurry Pump	2	No.	1W/Unit
13	Piping Instrumentation, Valves etc.	Lot		
14	Flue Gas Duct System	Lot		
15	Duct Expansion joint	Lot		
16	Insulation & Cladding for ducts	Lot		
2.03.00	**Limestone Slurry System**			
1	Mill Bunker	2	No.	(1W+1S)/Station
2	Silo/Bunker Outlet Gate	2	No.	1W/Silo/Bunker
3	Wet Ball Mill with drive system & lubricating system	2	No.	(1W+1S)/Station
4	Weighing Feeder	2	No.	1W/Mill
5	Mill Slurry (Separator) Tank	2	No.	1W/Mill

CLAUSE NO.	DESCRIPTION			
6	Mill Slurry Tank Agitators	2	No.	1W/Mill
7	Mill Circuit Pump	4	No.	(1W+1S)/Mill
8	Mill Hydrocyclone	2	No.	1W/Mill
9	Limestone Slurry Tank	2	No.	2/Station
10	Limestone Slurry Pumps	6	No.	(2W+1S)/Tank
11	Limestone Slurry Tank Agitators	2	No.	1W/Tank
12	Reagent (limestone) Preparation Area Sump	1	No	for both units
13	Reagent Preparation Area Sump Pump	2	No.	(1W+1S)/ for both units
14	Piping, instrumentation, valves etc.	LOT		Pipes/chutes with valves from mill and hydrocyclone to common slurry storage tanks further to absorber system
2.04.00	**GYPSUM DEWATERING SYSTEM**			
1	Primary Hydrocyclone Feed Tank	1	No.	1/Station
2	Primary Hydrocyclone Feed Pump	2	No.	(1W+1S)/Tank
3	Primary Hydrocyclone	2	Set.	(1W+1S)/Station
4	Vacuum Belt Filter	2	No.	
5	Vacuum Pump	2	No.	
6	Vacuum Receiver Tank	2	No.	(1W+1S)/Station
7	Cake wash water storage Tank	2	No.	(1W+1S)/Station
8	Belt & Cloth Wash Pump	4	No.	(1W+1S)/Vacuum belt filters
9	Cake Wash Pump	4	No.	For each vacuum belt filters
10	Filtrate Water Tank	1	No.	Common for both units
11	Filtrate Water Pumps	2	No.	Common for both

CLAUSE NO.	DESCRIPTION			
				units
12	Secondary Hydro cyclone Feed Tank	1	No.	1/Station
13	Secondary Hydro cyclone Feed Pump	2	No.	(1W+1S)/Tank
14	Secondary Hydro cyclone	2	Set	(1W+1S)/Station
15	Dewatering Area Sump	1	No.	for both units
15	Dewatering Area Sump Pump	2	No.	(1W+1S)/ Station
16	Piping, instrumentation, valves etc.		Lot	
2.05.00	**Waste Water Treatment System**			
1	Neutralization Tank	1	No	1/Station
2	Waste Water Tank	1	No	1/Station
3	Lime Feeding & Storage System	2	Set	(1W+1S)/Station
4	Waste Water Pumps	2	Nos.	(1W+1S)/Station
5	Piping, instrumentation, valves etc.	Lot		Piping to discharge waste water at required pressure
2.06.00	**Process Water System**			
1	Process Water Tank	2	No	2/Station
2	Process Water Pump	4	No	(1W+1S)/Tank
3	Booster Pump (if required)	2	No	(1W+1S)/Station
2.07.00	**Elevators**			
1	Passenger cum Goods elevator	2	Nos.	With minimum capacity of 1000 kgs for absorber & milling area
2.08.00	**LIMESTONE/GYSUM HANDLING PLANT**			
2.08.01	**Conveyors & Accessories**			
1	Belting	1000	Mtr	Belt Rating : 800mm wide synthetic, cover thick 5/2 mm, av. Belt strength 50/4 FR Grade
2	Carrying Idlers(Including SAC)	350	Nos.	35 deg. Trough., 3 roll,

CLAUSE NO.	DESCRIPTION			
3	Impact Idlers	110	Nos.	152 mm dia 4 mm thick, 2 deg. Tilt 35 deg. Trough., 3 roll, 152 mm dia 4 mm thick, 2 deg. Tilt along with rubber discs
4	Return Idlers (Including SAR)	150	Nos.	Double roll 10o through 152 mm dia, 4 mm shell thick
5	Short support, etc.	40	Te	a). MS fabricated
		10	Te	b). Chute work-20 thk TISCRAL
		260	Mtrs.	c). 60 lb/yd rail for (trippers)
6	Pulleys			
	a) Drive pulleys	15	Nos.	M.S. Fabricated, 950 mm face width, dia 800 mm dia
	b) Other pulleys, (Tail, snub,bend & take-up)	50	Nos.	M.S. fabricated, 950 mm face width, dia 800 mm dia
7	Drive motors for conveying system	15	Nos.	mm av. Dia 630 mm LT motors
8	Reduction gears	15	Nos.	Helical type with integral hold backs for drives in Sl.No.7
9	High speed coupling	15	Nos.	Pin bush type coupling
10	Low speed coupling	15	Nos.	Geared type coupling
11	Brakes	15	Nos.	Electro-hydraulic thruster type
12	Belt cleaners			
	a) Internal	15	Nos.	V-plough type
	b) External	30	Nos.	Double bladed spring loaded segmented Type
13	Flap gates	06	Nos	Motorized, M.S. fabricated
14	Rack & Pinion gates	06	Nos	MS fabricated, motorized
15	Rod gates	06	Nos	Manually operated, MS fabricated
16	Safety switches	Lot		Pull cord, beltsway, zero speed (Typical)
17	Sump pumps	04	Nos	50 m3/hr 15 mwc, vertical pump
18	Belt scales	02	Nos	Electronic type for continuous weighing

				for 150 TPH
19	In Line Magnetic Separator	2	Nos	Inline type, 1000 gauss (for 150 TPH conveyor)
20	Suspended Magnets	2	Nos	1000 gauss (for 150 TPH conveyor)
21	Metal detector	2	Nos	(for 150 TPH conveyor)
22	Lime Sampler Unit	1	No	For Raw Lime (-)250mm
23	Travelling Trippers	04	Nos	For 150 TPH (ratedCapacity)
24	Monorails & hoists	Lot	Nos	Electrical operated hoists, Manual hoists and Chain Pulley Block
25	Lime crusher with complete drive unit	2	Nos	165 TPH, Hammer Mill crusher
26	Vulcanising Machine	1	Nos	-
27	Passenger cum goods Elevator	1	Nos	1 T (Conventional type)
28	Dust Extraction system	Lot	Nos	
29	Ventilation system and Package AC	Lot	Nos	Typical
30	Service water system, Potable Water System	Lot	Nos	Typical
31	Mandatory spares	Lot		Typical
32	Special tools & tackles	Lot		Typical
33	Underground hopper with shed	04	Nos.	25 MT Each
34	Belt Feeder	08	Nos	100 TPH
35	Lime storage Silo	3	Nos	1800 T
36	Fluidising System	200	Nos	For Lime Storage silo
37	Bucket elevator	04	Nos	100 T
2.09.00	**EQUIPMENT COOLING WATER SYSTEM**			
1	Secondary Cooling Water pumps (FGD)	4	Nos.	Horiz,Centri; Each of 150-200M3/hr & 55 MWC (2W+2S)
2	DM cooling water pumps FGD	3	Nos.	Horiz,Centri; Each of 50 M3/hr & 45MWC Motor rating:7.5 KW

CLAUSE NO.	DESCRIPTION			
3	Plate type heat exchangers (FGD)	Lot		(2W+1S) 3 x 50% (With Titanium plates)
4	Chemical storage equipment and dosing system (FGD)	Lot		One for FGD System
5	GRP Pipes	1000	m	450 NB
2.10.00	**FIRE DETECTION & PROTECTION SYSTEM**			
1	Hydrant & spray system mains piping, indoor & outdoor hydrants, hoses, hose boxes, couplings etc.	Lot		
2	HVW Spray system for various equipments (Transformers, etc.)	Lot		
3	MVW Spray system for cable Galleries	Lot		
4	Analogue addressable fire detection and alarm system comprising multisensory detectors, Fire alarm panels, PLC panels, Remote I/O panels, etc.	Lot		
5	LHS cable for lime and Gypsum Conveyors & cable galleries along with interface unit for each zone & all supporting arrangement	Lot		
6	Cables & cabling for the complete fire detection, alarm & protection system	Lot		
7	Fire Extinguishers (Portable & mobile type)	Lot		
2.11.00	**COMPRESSED AIR SYSTEM**			
1	Air compressors with control panels, instrumentation & all accessories like piping, valves, etc.	2	Nos.	Screw type oil free compressors each of capacity 15 NM3/min (minimum) & discharge Pressure of 8.5 kg/cm2(g).
2	ADP with panels, instrumentation, all accessories like piping, valves & electronic dew point meters	2	Set	Capacity15 NM3/min. Design outlet dew point of (-) 40oC (atmospheric).
3	Air receivers	2	Nos.	Nominal Capacity: 2

				m3
2.12.00	**AIR CONDITIONING AND VENTILATION SYSTEM**			
2.12.01	**Air-Conditioning System for FGD Control Room**			
1	Air cooled condensing unit (D-X type) along with associated refrigerant piping, valves, instruments, etc.	2	Nos.	20 TR
2	Built-up double skin air handling units (AHUs)	2	Nos.	15000 CMH
3	Pan Humidifier along with all Accessories	Lot		
4	Electric strip heater together with Controls	Lot		
5	Cassette (Split)	8	Nos.	4.0 TR
6	Hi-Wall (Split)	8	Nos.	3.0 TR
2.12.02	**VENTILATION SYSTEM**			
1	Ventilation System for FGD Control room Building			
a	Double skin modular type central unitary air filtration units	1	Set	35000 CMH
b	DIDW centrifugal fans with drive motor	1	No.	35000 CMH Capacity at 40 MMWC
c	Circulating water pumps with drive motor	1	No.	210 M3/hr & 30 MWC
2.12.03	Accessories such as piping, ducting, grills, dampers, valves diffusers, dampers, instrumentation, panels, etc	Lot		
2.12.04	Ventilation System for Misc. areas comprising of supply & exhaust air fans, roof extractor fans, gravity dampers, etc.	Lot		

CLAUSE NO.	DESCRIPTION			
3.00.00	**ELECTRICAL**			
3.01.00	**TRANSFORMERS**			
(i)	FGD HT Transformers	2	Nos.	11/3.45kV, 12.5 MVA, ONAN, OCTC
(ii)	FGD LT Transformers	4	Nos	11/0.433kV, 2000 KVA, ONAN , OCTC
(iii)	FGD LT Transformers	3	Nos	11/0.433kV, 1600 KVA, ONAN , OCTC
3.02.00	**HT SWITCHGEARS**			
(i)	FGD Switchgear – 11KV	20	Panels	11KV, 1250A Bus bar rating. Incomers-1250A Outgoing – 630A. 40kA for 1 second.
(ii)	FGD Switchgear – 3.3 KV	15	Panels	3.3 KV, 2500A Bus bar rating. Incomers- 2500 A Outgoing – 630A. 40kA for 1 second.
(iii)	Retrofitting of existing 11 kV feeders of unit # 1&2 Station boards.	02	CBs	11KV, 1250A, 40kA for 1 second (BHEL make)
(iv)	Modification of Transformer feeders to motor feeders in Unit Boards	04	Panels	
3.03.00	**LT SWITCHGEARS**			
(i)	FGD LT Service Switchgear- Unitised	2	Set	3200A, 50 KA for 1 sec.
(ii)	FGD Common services SWGR	1	Set	2500A, 50 KA for 1 sec.
(iii)	Emergency FGD MCC – 1600 A	1	Set	1600A, 50 KA for 1 sec.
(iv)	415V AC Distribution Fuse Board	8	Set	
(v)	220V DC Distribution Board (DCDB)	1	Set	
(vi)	220V DC Fuse Board (DCFB)	6	Set	
(vii)	415V AC Main Lighting Distribution Board (MLDB)	3	Set	2X100KVA, 400A
(viii)	415V AC Emergency Lighting Distribution Board (ELDB),	2	Set	2X50KVA, 250A
(ix)	Local Stop Push button Stations	130	Nos.	Outdoor duty
(x)	Local Motor Starter	20	Nos.	Metalclad outdoor duty
(xi)	Junction Boxes	80	Nos.	GI

CLAUSE NO.	DESCRIPTION			
3.04.00	**BUSDUCT**			
(i)	Metal Enclosed Segregated Phase Busduct.	80	Mtrs.	3.3 KV, 2500 A
(ii)	Metal Enclosed Non – Segregated Phase Busduct	40	Mtrs.	415 V, 3200 A
(iii)	Metal Enclosed Non – Segregated Phase Busduct	40	Mtrs.	415 V, 2500 A
3.05.00	**BATTERY & BATTERY CHARGER**			
(i)	220 V, 90 AH Ni-Cd/ 150 AH Lead Acid Batteries	2	Nos.	220 V, 90 AH Ni-Cd/ 150 AH
(ii)	220V , 40A Float cum boost Chargers	2	Nos.	220V , 40A
3.06.00	**HT CABLES**			
3.06.01	**11 KV cable,**			
(i)	3C-150 sq. mm.	3	Km	Armoured, FRLS, XLPE insulated
(ii)	1C-300 sq. mm.	12	Km	Armoured, FRLS, XLPE insulated
(iii)	1C-630 sq. mm.	12	Km	Armoured, FRLS, XLPE insulated
3.06.02	**3.3 KV cable,**			
(i)	3C-150 sq. mm.	4	Km	Armoured, FRLS, XLPE insulated
(ii)	1C-185 sq. mm.	6	Km	Armoured, FRLS, XLPE insulated
3.07.00	**LT CABLES**			
(i)	1.1KV LT Power cables	100	Km	Armoured, FRLS,
(ii)	1.1KV LT Control cables	30	Km	Armoured, FRLS,
3.08.00	**CABLE TRAYS & SUPPORTS**			
(i)	Cable Trays	18	Km	Ladder/Perforated GI
(ii)	Cable Tray Supports & Accessories	1	Lot	
3.09.00	**MISCELLANEOUS ELECTRICAL**			
(i)	DG Set,	1	No.	630 KVA, 415 V
(ii)	Cabling	1	Lot	
(iii)	Earthing & Lightning Protection	1	Lot	
(iv)	Illumination System	1	Lot	

CLAUSE NO.	DESCRIPTION	
4.00.00	**CONTROL & INSTRUMENTATION SYSTEM** **FGD System including Compressed air system, Air conditioning system, Ventilation system, FDPS etc.**	
1	DDCMIS based control system including HMIPIS, Furniture & rack etc with Annual Maintenance Contract (AMC)	LOT
2	Measuring Instruments (Temperature elements with transmitters, Pressure transmitters, Ultrasonic/Radar type level transmitters, pressure/ temperature gauges, Flow Transmitters, Analyzers, Vibration monitoring system etc.)	LOT
3	Junction boxes, Instrumentation & control cables	LOT
4	Process connection and piping including LIE/LIR	LOT
5	24 V DC and 240 V AC UPS power supply system	LOT
6	Pneumatic Control valves, actuators and accessories	LOT
7	Tools & Tackles	LOT

CHAPTER-17
RECOMMENDATIONS

Recommendations for control of Sulphur Dioxide (SO_2 control)

Based on the data provided by SCCL, a comparative study of available technologies was undertaken for control of SO_2 and **Wet Limestone–Gypsum Forced Oxidation technology** was found most suitable for the Singareni TPP (2X600 MW) . This report clearly brings out the performance expectation, layout requirement for the system and its accommodation in the existing plant, SO_2 reduction process which is undertaken and the efficacy of the process (above 95%), sources of the reagent (limestone) in India and disposal of the by-products (gypsum) of the desulphurization process in various utilities. Based on the Detail Project Report, the suitable technical specification needs to be prepared for the FGD system.

Recommendations for control of Oxide of Nitrogen (NOx control)

As per the scope of work, Combustion Modification-Low NOx burner is the most suitable technology for Singareni TPP (2X600 MW).

In this process following modification are likely to be undertaken in the boiler i.e. new/modified Re-designed Wind box including new coal, oil and air nozzle tips for all four corners, New Re-designed Tilting Tangential Burner Assembly, Burner Tilt Power cylinders, Modification in coal piping, coupling & its supports which requires boiler down time as per implementation schedule. This process has one time capital expenditure with no requirement of operational expenditure during running of the plant and is having high reliability.

APPENDIX - 'C'

[of Capital Investment plan]

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Bharat Heavy Electricals Limited
(A Government of India Undertaking)
Power Sector - Spares & Services Business Group (R & M Division)
II Floor, KRIBHCO BHAWAN, A 8-10, Sector 1, NOIDA - 201301
Ph: 0120-2440836; Fax: 0120- 2532158; E-mail: gurpreet@bhel.in

Ref: PS/SSBG/R&M/F-1564
Date: 31st January 2019

Shri. JN Singh
Chief (O&M)
Singareni Thermal Power Plant,
Pegadapalli, Jaipur,
Telangana 504216

Sub: NOx Mitigation System for 2X600 MW Singareni TPS Unit 1 & 2 of M/s SCCL

Ref: 1. SCCL letter dtd 08.08.2018.
2. BHEL Budgetary offer dtd 06.09.2018.
3. BHEL presentation reg. DE-NOx at SCCL site dtd 09.01.2019.

Dear Sir,

We thank you very much for the hospitality offered by M/s SCCL to team BHEL during their visit to Singareni site on 09.01.2019.

For designing the NOx mitigation system, BHEL has considered the baseline value of NOx emission as 480 mg/Nm3 for both the units (as furnished by SCCL vide their letter cited at Sl#1 under reference). As explained during the presentation made at site, BHEL will be offering Combustion modification package (In-furnace) including two level SOFA arrangement for abatement of the NOx emissions. The above system will be able to reduce the NOx emissions by 40%. (i.e. NOx level could be brought down to the range of 280-290 mg/Nm3).

Budgetary Price for the NOx mitigation system (as furnished vide BHEL letter dtd 06.09.2018) for both the units is **INR 37.88 Crores** (Inclusive of Freight, Insurance and GST). As discussed during the meeting at site, a minimum of 45 Days shutdown would be required to implement the said package. Other Terms & conditions may be agreed mutually on a convenient date, time and venue.

We look forward for your esteemed order on us as soon as possible.

Thanking you and assuring of our best services always,

Yours faithfully,
for **Bharat Heavy Electricals Limited**

31/01/2019

Gurpreet Singh
Senior Engineer
BHEL- SSBG(R&M)

APPENDIX - 'D'

[of Capital Investment plan]

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BHARAT HEAVY ELECTRICALS LIMITED

(A Govt. of India Undertaking)
Power Sector: Spares & Services Business Group
Ek Tara Building, 39-Sarojini Devi Road, Secunderabad-500003
Ph: 040-27718968/27704643/27701259, Fax: 040-27710280
E-mail: rksingh@bhel.in; shaukat@bhel.in

Ref: PS: SSBG: SEC: STP: 030: HWT: Bud: GVK: **Date: 24.10.2018.**

Shri M V VENUGOPAL RAO,
DGM - OPERATIONS (MECHANICAL), PHONE: 08333991925
2x600MW, Singareni Thermal Power Project,
The Singareni Collieries Company Limited,
Jaipur (V&M), Adilabad (Dt),
Telangana-504216.

Sir,

Sub: Budgetary offer for Major Modules for SCCL-reg.
Ref: E-mail message dated 12.10.2018.

With ref to the above, we are pleased to submit our budgetary offer as per enclosed annexure-A. Other terms and conditions are as given below.

1) Quoted prices are FOR Ex-works-BHEL Haridwar.
2) Offer shall be valid up to 31.12.2018.
3) All the terms & conditions of the contract with respect to Taxes & Duties are subject to the new taxation laws introduced from time to time (e.g., GST). The terms & conditions will be modified in accordance with the provisions of new laws (e.g., GST). Present rates are IGST-18%.
4) The contractual delivery period of these spares shall be 24 months from the date of receipt of technically clear & commercially firm purchase order.
5) PO should be in line with our offer. Deviation in terms & condition from our offer is not acceptable.

Kindly arrange to process our offer for placement of order at the earliest.

Thanking you.

Yours faithfully,

(Shaukat Ali)
Manager, SSBG

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ANNEXURE-A

Ref: PS: SSBG: SEC: STP: 030: HWT: Bud: GVK: **Date: 24.10.2018.**

Sl NO	Description	Qty	Unit Ex-works Price in Rs
1	HP MODULE	1 No	465045000
2	IP MODULE	1 No	538125000
3	LP TURBINE ROTOR-1	1 No	252000000
4	LP TURBINE ROTOR-2	1 No	252000000
5	GENERATOR STATOR	1 No	630000000
6	GENERATOR ROTOR	1 No	383250000
7	EXCITER ASSEMBLY*	1 No	220500000
TOTAL EX-WORKS VALUE IN RS			274,09,20,000

Amount in words: Rupees Two Hundred Seventy Four Crores Nine Lakhs Twenty Thousand Only.

Note: For item no: 7, EXCITER ASSEMBLY

1. Price of exciter cooler is not considered.
2. Price of bed plate access and rack assembly, bed plate accessories, fuse monitoring, Dry air blower installation and assembly of covers are not considered.

QUALITY PLAN:

1) All material supplied by BHEL shall be inspected as per BHEL standard procedure and practices. BHEL shall submit Certificate of Compliance (COC) only for these spares.
2) Kindly note that BHEL may procure raw material in semi-finished/finished condition from their approved and established vendors.
3) We will ensure the warranty and interchangeability of the spares, but no physical certificate (TC/GC) shall be furnished.
4) Budgetary offers are submitted to facilitate you for estimation and are provisional only. Prices may vary from time to time. Please don't compare these budgetary offer prices with your firm offers.
5) Kindly release firm enquiry/Purchase order to enable us to plan our Manufacturing activity to suit your delivery requirement.

APPENDIX-E

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I.W. No 3679
Date 15-11-18

.../2018/O/o Secy

New Delhi. Dated: 27.09.2018

No. 2018/RE/161/22

Dear Shri Singh,

Sub: Electrification of Coal sidings.

Cabinet has accorded sanction for electrification of balance un-electrified broad gauge routes of Indian Railway (13,675 route kilometers/16,540 track kilometers) vide Cabinet Secretariat OM No. CCEA/26/2018 dated 13.09.2018. It is essential to electrify all sidings of Coal India for smooth train operation on electric traction. However this may need special OHE arrangement for facilitating mechanized coal loading at wharf & coal hopper, where loading is done through JCB & Chute respectively.

May I therefore, request you to take immediate action for electrification of all coal sidings so as to achieve seamless operation of coal rakes on electric traction.

With Regards,

Yours Sincerely,

(Ghanshyam Singh)

Dr. Inder Jit Singh
Secretary
Ministry of Coal
Shastri Bhawan
New Delhi – 11001

Director (E&M)

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No. 43012/40/2012-CPAM (VI)-Part(1)
Government of India
Ministry of Coal
(CPAM Section)
***

Shastri Bhawan, New Delhi
Date: ~~25.10.~~2018
05/11/2018

To

01	**Chairman,** Coal India Limited, Coal Bhavan, (W.B) E-mail: chairman.cil@coalindia.in
02	**CMD**, Eastern Coalfields Limited, (W.B) E-mail: cmd.ecl.cil@coalindia.in
03	**CMD**, Central Coalfields Limited, (Jharkhand) E-mail: cmd.ccl.cil@coalindia.in
04	**CMD**, Northern Coalfields Limited, (M.P). E-mail: cmd.ncl.cil@coalindia.in
05	**CMD**, Bharat Coking Coal Limited, (Jharkhand) E-mail: cmd.bccl.cil@coalindia.in
06	**CMD**, Mahanadi Coalfields Limited, (Odisha) E-mail: cmd.mcl.cil@coalindia.in
07	**CMD**, Western Coalfields Limited, (Maharashtra) E-mail: cmd.wcl.cil@coalindia.in
08	**CMD**, South Eastern Coalfields Limited,(Chhattisgarh) E-mail: cmd.secl.cil@coalindia.in
09	**CMD**, NLCIL, (Tamil Nadu) E-mail:cmd@nlcindia.com
10	**CMD**, Singareni Collieries Company Limited, (Telangana) E-mail:cmd@scclmines.com, roscel@rediffmail.com

Subject: Electrification of Coal sidings - reg.

Sir,

I am directed to refer to forward herewith D.O. No. 2018/RE/161/22 dated 27.09.2018 received from Ministry of Railways on the subject mentioned above and to request you to kindly take appropriate action.

Yours sincerely,

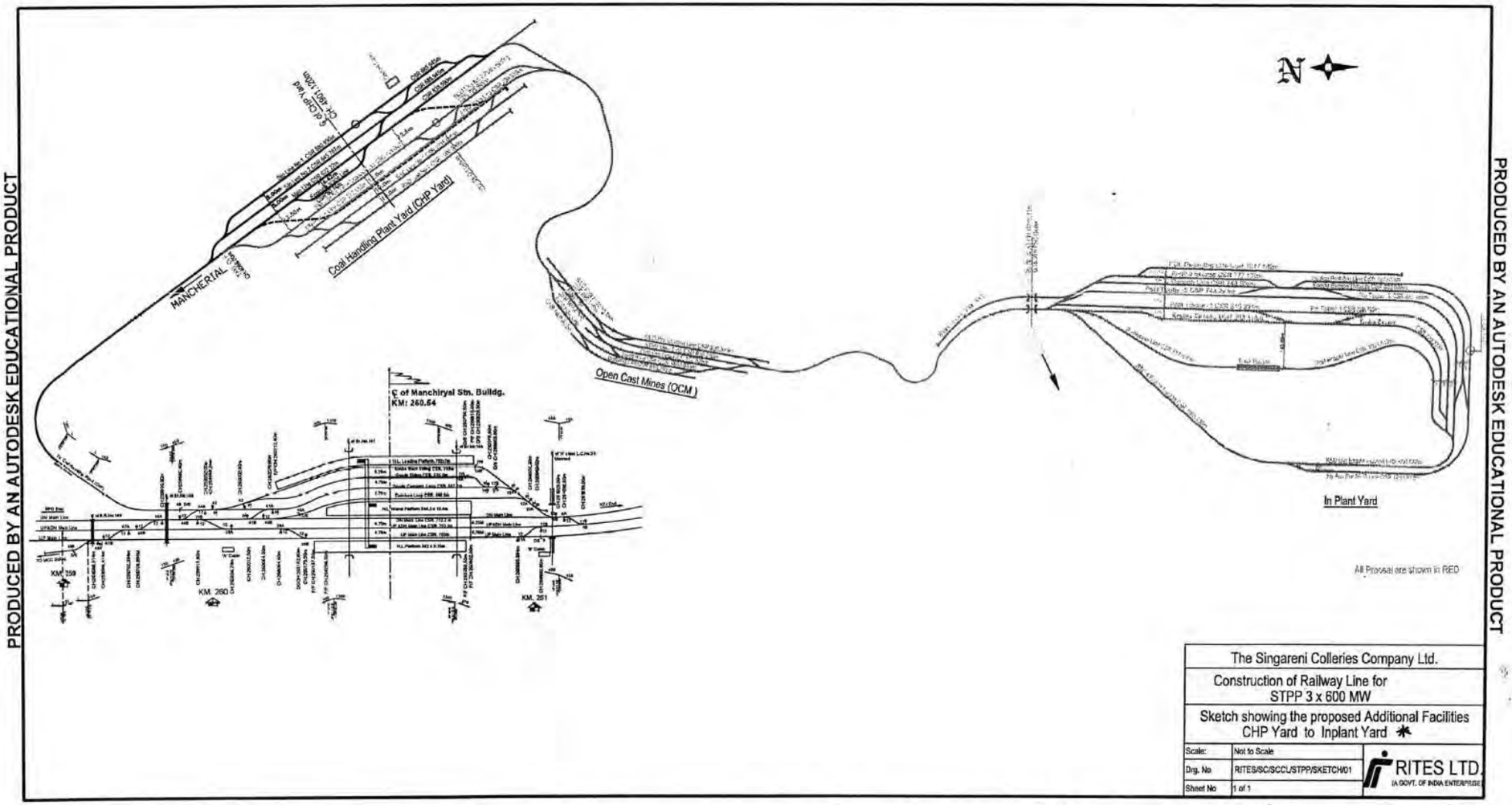
Encl.: As Above (E-mailed)

5/11/2018
(A. K. Mandal)
Under Secretary to the Government of India
Telephone No. 011-23382269

EXECUTIVE DIRECTOR (C.M.) S.C.C.L. HYDERABAD. 5/11/18

O/o. Dir. (E&M)
In Ward

ED / STPP



PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

* This work is already completed. Now signalling & Telecommunication (S&T) work is proposed to be undertaken in 2013-24.

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THE SINGARENI COLLIERIES COMPANY LTD

(A GOVERENMENT COMPANY)

2X600 MW , SINGARENI THERMAL POWER PROJECT

JAIPUR (V & M) , PIN 504216, MANCHERIAL DIST , TELENGANA STATE

Statement showing break-up of actual capital cost of STPP up to CoD of U-1 , CoD of U-2 , addl cap exp beyond CoD of U-2 in FY 2016-17, FY 2017-18, upto 30.09.2018 & Estimated upto 31.03.2019

Rupees in crores

DPR Head	As per Tariff filing in 2/2016	Cost Approved as per Revised Cost Estimate -2	Up to COD U-1 (25.09.2016)	Oct-Nov'16 (From COD1 to COD2)	Up to COD U-2 (02.12.2016)	Actual as on 31.03.2017	Actual as on 31.03.2018	Actual as on 30.09.2018	Estimated Capital Cost as on 31.03.2019
1. BTG Package									
BTG Total	**4878.00**	**4934.50**	**4749.95**	**31.59**	**4781.54**	**4772.14**	**4772.14**	**4,810.61**	**4934.50**
2. BOP Package									
BoP Total	**1038.00**	**1020.00**	**837.26**	**27.70**	**864.96**	**877.10**	**977.42**	**986.72**	**1020.00**
3.SCCL Scope works									
Land*	59.00	50.00	39.70	0.66	40.36	39.71	39.87	51.82	51.82
Survey & Soil Investigation	1.00	0.30	0.02	0.00	0.02	0.02	0.02	0.02	0.30
Site Dev, Enabling,Temp Sheds	25.00	24.00	21.35	0.00	21.35	23.38	23.39	23.39	24.00
Roads & Culverts	20.00	20.00	11.44	0.00	11.44	11.75	12.34	12.41	20.00
Coal transport roads	56.48	52.00	42.61	0.00	42.61	45.72	44.63	44.16	52.00
Boundary walls	17.00	19.00	16.58	0.36	16.94	17.19	17.19	17.19	19.00
Reservoir	67.00	58.00	42.93	0.24	43.17	46.07	51.48	51.52	58.00
Water supply-1 TMC	86.00	85.00	79.86	3.62	83.48	83.96	84.18	84.22	85.00
Water supply-2 TMC(incl elec)	320.00	293.00	240.78	4.53	245.31	250.38	274.53	308.22	320.00
Gate complex, Security etc	5.40	5.40	0.23	0.00	0.23	0.60	1.45	1.34	5.40
Rly Siding**	80.00	380.00	78.53	2.21	80.74	153.10	270.87	293.69	380.00
Township & GH	145.00	145.00	50.20	1.98	52.18	63.50	90.30	99.39	145.00
Environment	5.00	4.00	0.74	0.05	0.79	0.78	0.87	1.20	4.00
CSR *	22.10	22.10	9.29	0.16	9.45	10.05	10.73	11.00	22.10
Weigh bridges, fire tender etc	2.00	2.00	0.42	0.00	0.42	0.45	0.45	0.45	2.00
Start up power & commcn eqpt	42.00	49.00	42.00	0.00	42.00	48.02	48.02	48.02	49.00
Construction power	25.00	30.00	24.66	0.31	24.97	24.40	24.40	24.40	30.00
Furniture & office automation	5.00	6.00	2.37	0.00	2.37	2.18	2.72	4.16	6.00
Misc Expenditure	5.00	8.00	3.25	0.23	3.48	3.99	4.50	4.50	8.00
BAY, CCT & CVTs	**0.00**	28.70	0	0	0.00	0.00	28.70	30.74	30.74
SCCL ScopeTotal	**987.98**	**1,281.50**	**706.96**	**14.35**	**721.31**	**825.27**	**1,030.64**	**1,111.85**	**1,312.36**

Appendix-F

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DPR Head	As per Tariff filing in 2/2016	Cost Approved as per Revised Cost Estimate -2	Up to COD U-1 (25.09.2016)	Oct-Nov'16 (From COD1 to COD2)	Up to COD U-2 (02.12.2016)	Actual as on 31.03.2017	Actual as on 31.03.2018	Actual as on 30.09.2018	Estimated Capital Cost as on 31.03.2019
4. OTHERS									
Contingencies	47.52	5.00	11.32	0.00	11.32	13.79	16.20	16.20	16.20
Establishment costs	70.00	94.00	69.80	0.00	69.80	89.89	88.73	92.13	94.00
Consultancy & Engg	127.00	120.00	107.77	1.96	109.73	114.93	119.44	119.44	120.00
Start up fuel	40.00	41.00	38.69	2.09	40.78	40.20	40.20	40.20	40.20
Operator Training	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Development exp	0.00	0.00	0.00	0.00	0.00	2.96	2.96	2.96	2.96
Margin Money	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Financing Expenses	2.00	1.00	0.00	0.00	0.00	0.50	0.50	0.50	1.00
Interest during construction	1058.00	1266.00	1231.73	32.61	1264.34	1280.98	1302.53	1,264.34	1,264.34
O&M-Expenditure upto COD	0.00	17.00	18.15	2.75	20.90	16.90	17.00	17.00	17.00
Others Total	**1346.02**	**1544.00**	**1477.46**	**39.41**	**1516.87**	**1560.14**	**1587.56**	**1,552.77**	**1555.70**
Grand Total	**8250.00**	**8780.00**	**7771.63**	**113.05**	**7884.68**	**8034.65**	**8367.76**	**8461.94**	**8822.56**

** Railway Expenditure is inclusive of CCDAC Claim Receivable of Rs.175 crs

Notes:

1. Advances given against MDCC are considered as Expenditure upto COD-2
2. Due to SAP Configuration, Back date Posting of Expenditure is Not Allowed even though expenditure is related to before COD date
3. Delay in Submission of Bills by BHEL even after completion of work upto COD
4. PVC bills & Mandatory Spare Bills Subsequently submitted after COD by BHEL
5. Land value includes deposits 8.66 crs which was not accounted due to SAP Configuration as at 30.09.2018
6. CSR expenditure can be read as Mandatory capital expenditure under MoEF clearance.
7. IDC Incurred after COD of unit -2 is allocated to the balance of assets as on 30.09.2018.

Verified & found correct.

For RAMAMOORTHY (N) & Co.,
Chartered Accountants
FRN: 02899 S

CA. Surendranath Bharathi
Partner
Mem. No: 023837

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Appendix-III

Statement of liability

Name of the Company: **The Singareni Collieries Company Limited**
Name of the Power Station: **Singareni Thermal Power Project**

Sl. No.	Breakdown	Actual capital cost as on 31.03.2017	Amount Disbursed upto 31.03.2017	Liability as on 31.03.2017	Actual capital cost as on 31.03.2018	Amount Disbursed upto 31.03.2018	Liability as on 31.03.2018	Actual capital cost as on 30.09.2018	Amount Disbursed upto 30.09.2018	Liability as on 30.09.2018
(1)	(2)									
1	BTG package									
1.1	BTG Supply									
1.2	BTG Erection									
1.3	BTG Freight									
1.4	BTG Civil									
1.5	Subtotal									
1.6	PVC									
1.7	Increase in taxes and duties									
1.8	**BTG Grand Total**	**4,772.14**	**4,355.75**	**416.39**	**4,772.14**	**4,592.84**	**179.30**	**4,810.61**	**4,626.73**	**184.88**
2	**BOP package**									
2.1	BOP Mechanical& Electrical (supply)									
2.2	BOP Civil									
2.3	BOP Erection									
2.4	BOP Freight									
2.5	Subtotal									
2.6	Estimated PVC									
2.7	**BOP Total**	**877.10**	**872.80**	**4.30**	**977.42**	**946.30**	**31.12**	**986.72**	**959.24**	**27.48**
3	**Other works undertaken by SCCL**									
3.1	Land	39.71	39.71	-	39.87	39.87	0	51.82	51.82	-
3.2	Survey & soil investigation	0.02	0.02	-	0.02	0.02	0	0.02	0.02	-
3.3	Site Dev, Enabling, temp Sheds etc.	23.38	23.38	-	23.39	23.39	0	23.39	23.39	-
3.4	Roads & Culverts	11.75	11.75	-	12.34	12.34	0	12.41	12.41	-
3.5	Coal Transport Roads out of BOP savings	45.72	45.72	-	44.63	44.63	0	44.16	44.16	-
3.6	Boundary Walls	17.19	17.19	-	17.19	17.19	0	17.19	17.19	-
3.7	Reservoir	46.07	46.07	-	51.48	51.48	0	51.52	51.52	-
3.8	Water supply-1 TMC	83.96	83.96	-	84.18	84.18	0	84.22	84.22	-
3.9	Water supply-2 TMC	250.38	250.38	-	274.53	274.53	0	308.22	308.22	-
3.10	Gate Complex, Security, etc.	0.60	0.60	-	1.45	1.45	0	1.34	1.34	-
3.11	Railway Siding	153.10	153.10	-	270.87	270.87	0	293.69	293.69	-
3.12	Township & Guest House & other amenities	63.50	63.50	-	90.30	90.30	0	99.39	99.39	-
3.13	Environment	0.78	0.78	-	0.87	0.87	0	1.20	1.20	-
3.14	CSR	10.05	10.05	-	10.73	10.73	0	11.00	11.00	-
3.15	Weigh Bridges, Fire Tender	0.45	0.42	0.03	0.45	0.45	0	0.45	0.45	-
3.16	Start up Power & common Equipment	48.02	48.02	-	48.02	48.02	0	48.02	48.02	-
3.17	Construction Power	24.40	24.40	-	24.40	24.40	0	24.40	24.40	-
3.18	Furniture & office automation	2.18	2.18	-	2.72	2.72	0	4.16	4.16	-
3.19	Misc Expenditure	3.99	3.99	-	4.50	4.50	0	4.50	4.50	-
3.20	BAY,CT and CVT	-	-	-	28.70	28.70	0	30.74	30.74	-
3.21	**Other works undertaken by SCCL Total**	**825.25**	**825.22**	**0.03**	**1,030.65**	**1,030.65**		**1,111.84**	**1,111.84**	-

Rupees in crores

DPR Head	Actual as on 30.09.2018	Estimated Capital Cost as on 31.03.2019	Estimated cost between 01.10.2018 to 31.03.2019 (as on 28.11.2018)	Expected Spill Over after 31.03.2019	Remarks
. BTG Package					
BTG Total	**4810.61**	**4934.50**	123.89	0.00	
. BOP Package					
BoP Total	**986.72**	**1020.00**	33.28	0.00	
.SCCL Scope works					
Land*	51.82	51.82	0.00		
Survey & Soil Investigation	0.02	0.30	0.28		
Site Dev, Enabling,Temp Sheds	23.39	24.00	0.61		
Roads & Culverts	12.41	20.00	7.59		
Coal transport roads	44.16	52.00	7.84		
Boundary walls	17.19	19.00	1.81		
Reservoir	51.52	58.00	6.48		
Water supply-1 TMC	84.22	85.00	0.78		
Water supply-2 TMC(incl elec)	308.22	320.00	11.78		
Gate complex, Security etc	1.34	5.40	4.06		
Rly Siding**	293.69	380.00	86.31	22.00	□ Codal charges have to be paid to railways (on completion cost of railway line) after completion & commissioning of the total siding. □ Project Management Consultant (PMC) charges have to be paid to RITEs (on completion cost of railway line) after completion & commissioning of the total siding. □ Track linking work is in progress and is expected for completion by 30.04.2019. Bills of expenditure/ final bill payable on this work.
Township & GH	99.39	145.00	45.61	22.70	M/s Sunil Hitech Engineers Limited got admitted in NCLT. Thereby, progress of the works affected. When the IRP (Interim Resolution Professional)assured for payments, works are restarted and the works are in progress.
Environment	1.20	4.00	2.80		
CSR *	11.00	22.10	11.10	9.00	CSR works are being taken up by the District Collector : Mancherial.30 % advance amounts were released to the District Collector for various approved works and Claims are yet to be receivedfor the balance 70%.
Weigh bridges, fire tender etc	0.45	2.00	1.55		
Start up power & commcn eqpt	48.02	49.00	0.98		
Construction power	24.40	30.00	5.60		
Furniture & office automation	4.16	6.00	1.84		
Misc Expenditure	4.50	8.00	3.50	3.00	Contingency in nature being monitored different departments of STPP. Executed as per the requirement.
BAY, CCT & CVTs	30.74	30.74	0.00		
SCCL ScopeTotal	**1111.85**	**1312.36**	**200.51**	**56.70**	
4. OTHERS					
Contingencies	16.20	16.20	0.00		
Establishment costs	92.13	94.00	1.87		
Consultancy & Engg	119.44	120.00	0.56		
Start up fuel	40.20	40.20	0.00		
Operator Training	0.00	0.00	0.00		
Development exp	2.96	2.96	0.00		
Margin Money	0.00	0.00	0.00		
Financing Expenses	0.50	1.00	0.50		
Interest during construction	1264.34	1264.34	0.00		
O&M-Expenditure upto COD	17.00	17.00	0.00		
Others Total	**1552.77**	**1555.70**	**2.93**	0.00	

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Annexure II

THE SINGARENI COLLIERIES COMPANY LIMITED
(A Government Company)
2 X 600 MW SINGARENI THERMAL POWER PLANT
Jaipur (V&M)-504216, Mancherial (Dist), Telangana State.

Ref No: STPP/COML/2019-20/45/61 Dt.18.03.2019

NOTE

Sub: Approval for submission of ARR and MYT petition and Business and Payment of requisite filing fee to TSERC along with required authorization for filing Multi-year tariff petition for ensuing control period of 2019-24.

*****

1. SCCL has established Singareni thermal power plant (STPP) in Jaipur, Telangana in FY 2016-17. SCCL had entered into a Power Purchase Agreement (PPA) with two Distribution companies of Telangana for supplying the total power generated from STPP at a tariff decided by hon'ble Telangana State Electricity Regulatory Commission (TSERC).

2. The Hon'ble TSERC has notified terms and condition for determination of generation tariff regulation 2019 on 04.01.2019. This regulation shall be applicable to all existing and future generating entities for determination of annual revenue requirement in the state of Telangana from 1st April 2019 to 31st March 2024.

3. SCCL has to submit Aggregate Revenue Requirement and Multi-Year tariff petition 2019-24,Business Plan 2019-24 and Capital investment Plan 2019-24 within 31st March 2019 before the Hon'ble TSERC as per regulation 3.8.1, regulation 7 and regulation 27 of generation tariff regulation 2019.The relevant portion of regulation is attached as Flag -A.

4. The capital investment plan is already approved by the competent authority. Further to this, the Aggregate revenue requirement (ARR) and Business Plan are made with the necessary inputs from O&M, finance, Civil, Coal, Personnel & E&M department for submission. The same is now ready for submission to

TSERC. The copy of ARR is attached in Flag -B and copy of business plan is attached in Flag-C.

5. As per Telangana State Electricity Regulation commission, Hyderabad (Conduct of Business) Regulations, 2015, Chapter II, point Sl. No. 11(5), the proceedings initiated before the commission is to be signed by the Managing Director or a Director of the Company. Any other person signing the petition should have authorization from the Board of Directors by a specific or general resolution. Copy of the relevant portion of the regulation is attached as Flag D.

6. Further, as per Sl.No. 4.3.a of Regulation no. 2 of 2016 "Levy of fees for various services rendered by the commission" a fee of Rs 20,000/- per MW with a maximum of Rs 150 lakhs. Further, business plan and capital investment plan can be filed under section 94(2) for which a fee of 10,000 each will be required as per 4.4.c of the fees regulations. Copy of the relevant portion is attached as Flag E.

7. It is to submit that the Director (Finance) was authorized to sign the Tariff Petition for the first control period (2016-19).

8. Accordingly, it is kindly requested to approve

   I. The ARR and MYT petition and Business Plan for submission to TSERC
   II. Payment of Rs 150 Lakhs to TSERC towards tariff filing fee along with tariff application.
   III. Payment of 20 thousand (10 thousand each) towards filing fee for Business plan & capital investment plan.
   IV. Authorisation of Director (Finance) to sign tariff application of STPP (2X600MW) & all other associated filing related to tariff (Business plan & Capital investment plan) for 2019-24 as it was done previously.

18.3.19

DGM(R&C)/STPP

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Ref No: STPP/COML/2019-20/45 Dt.18.03.2019

GM (F&A), STPP 18/3.

ED, STPP 18/3

22/3
GM (F&A)/Corporate

Director (E&M)

Signed on fax.
Director (P&P)

Director (Operations) 22/3

Director (Finance) 22/3

C&MD

OFFICE OF G.M. (F&A)
F.M.S. IN No 2288
DATE 20/3/19

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Dt.18.03.2019

Ref No: STPP/COML/2019-20/45

GM (F&A), STPP 18/3

ED, STPP 18/3

22/3
GM (F&A)/Corporate

Director (E&M)

Director (P&P)

Director (Operations)

Director (Finance)

C&MD

3 |

OFFICE OF G.M. (F&A)
M.S. IN No 2288
DATE 20/3/19

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Annexure III

भारतीय स्टेट बैंक
State Bank of India

बैंकर्स चैक
BANKERS CHEQUE

Key: VIHDEV
Sr. No: 360713

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ले करने वाले का नाम
uing Branch:COMMERCIAL BRANCH HYDERABAD
BR/CODE No: 04168
No. 040-24757979

PAY SECRETARY, TSERC, HYDERABAD **********

को या उनके आदेश पर
OR ORDER

रुपये RUPEES Ten Thousand Only

अदा करें ₹ 10000.00

C. 00051753068 Key: VIHDEV Sr. No: 360713 AMOUNT BELOW 10001(1/5)
Name of Applicant THE SINGARENI COLLIERIES COMPA

FOR STATE BANK OF INDIA

अहस्तांतरणीय / NOT TRANSFERABLE

प्राधिकृत हस्ताक्षरकर्ता
AUTHORISED SIGNATORY

शाखा प्रबंधक
BRANCH MANAGER

कम्प्यूटर द्वारा मुद्रित होने पर ही वैध
VALID ONLY IF COMPUTER PRINTED

केवल 3 महीने के लिए वैध
VALID FOR 3 MONTHS ONLY

₹ 1,50,000/- एवं अधिक के लिखत दो अधिकारियों द्वारा हस्ताक्षरित होने पर ही वैध है।
INSTRUMENTS FOR ₹ 1,50,000/- & ABOVE ARE NOT VALID UNLESS SIGNED BY TWO OFFICERS

S.T.K. GOPI
G-5196
SBI, Comm. Br-(4168)
Ph: 040-23466808

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