LALPIR POWER LIMITED

NISHAT GROUP

For information & n/a A.
— D/Reg/AR-II
Copy to:
— SA (Tech)
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29.8.14
cc: VC/M(Lic)
M(T)
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M(TM&E)

Dy No. 7037
Dated 29-08-14

LP/14/8867
August 26, 2014

The Registrar
National Electric Power Regulatory Authority,
Islamabad.

Subject: **Petition for Determination of Tariff - Coal conversation of LalPir Power**

Dear Sir,

Please refer to your letter NEPRA/TRF-100/9012 dated August 07, 2014 on the subject and our letter dated Aug 11, 2014.

In its letter, NEPRA had sought some information after their initial scrutiny and asked us to re-file the petition initially filed by us on July 28 and received by NEPRA on Aug 04, 2014. We are re-filing the Tariff petition with the following additional information:

1. The comparative Schedule of Charges, unit, price comprising the existing and the proposed tariff. NEPRA would appreciate it that the existing tariff is based upon 1994 bulk power tariff, hence doesn't provide break -up of the Escalable component of the Capacity Purchase price while our proposed tariff has given such break up.
2. Affidavit under Rule 3(8) of the Tariff Rules
3. Board Resolution to Authorize and File the Petition
4. Break- up of the proposed EPC Cost
5. Specification, make and model of the new boiler
6. Justification for selecting subcritical technology against super critical
7. Salvage value of the Boiler along with auxiliaries and its dismantling cost estimate
8. New Boiler Efficiency and the efficiency of the existing Turbine

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9. Details of the existing land holding
10. Details of the new land and proposed land development charges
11. Detailed break -up of the Proposed Development and Construction Management Costs
12. Calculations of proposed financial charges
13. Calculations of Return on Equity Component of proposed tariff
14. Details of the existing updated CPP
15. Justification of using existing variable O&M component of the tariff for the converted complex
16. Calculations of the fixed O&M of the Coal Complex
17. Detailed comparison of the existing and proposed tariff.
18. Estimated savings over the life of the project and payback period

We have also incorporated the above information in our revised petition. However, above information is attached as per Annexures for convenience.

In addition to the requisite information, we have attached the following information for NEPRA's perusal:

1. Detailed comparison of proposed tariff with the 350 MW coal Project upfront tariff showing increase / decrease in each year
2. Calculations of Working capital based upon RFO and Coal
3. Copies of EPC proposals received from various EPC contractors. (Please note that Mitsubishi Heavy Industries only submitted budgetary proposal).
4. Technical Evaluation of bids by CdF INGENIERE, France.

We reiterate our commitment to work with NEPRA in smooth determination of our tariff petition. We should be able to provide any additional information sought by NEPRA during tariff determination

Kind regards,

(Khalid Qadeer)

Director

LALPIR POWER LIMITED

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BEFORE
THE NATIONAL ELECTRIC
POWER REGULATORY AUTHORITY

PETITION FOR TARIFF DETERMINATION

BY: LALPIR POWER LIMITED

IN RESPECT OF
COAL CONVERSION OF
362 MW POWER PLANT AT MAUZA VERAR SEPRA DISTRICT MUZAFFARGARH

Dated: 27 August 2014

Technical Consultants	Legal Consultants
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GLOSSARY

Company/Petitioner	Lal Pir Power Limited
NG	Nishat Group
COD	Commercial Operations Date
CPI	Consumer Price Index
CC	Capacity Charge
CSA	Coal Supply Agreement
EC	Energy Charge
ECC	Economic Coordination Council of the GOP
EPCC	Equipment, Procurement & Construction Contract
IDC	Interest During Construction
IRR	Internal Rate of Return
KIBOR	Karachi Inter Bank Offered Rate
Km	Kilometer
Kw	Kilowatt
KWh	Kilowatt hour
LIBOR	London Inter Bank Offered Rate
LOS	Letter of Support
MW	Megawatt
MWh	Megawatt hour
NEPRA/ Authority	National Electric Power Regulatory Authority
NTDC/Power Purchaser	National Transmission and Dispatch Company Limited
O&M	Operation & Maintenance
PKR / Rs.	Pakistani Rupee
POE	Panel of Expert
PPA	Power Purchase Agreement
PPIB	Private Power & Infrastructure Board
Project	The Company's proposed to convert 362 MW (Gross, ISO) HFO fired power project to coal firing at District Muzaffargarh, Punjab
ROE	Return on Equity
Existing Contract or PPA	PPA between WAPDA and Company dated 3 November 1994
Ton	Metric Ton i.e. 1000kg
USD	United States Dollar

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A. PARTICULARS OF PETITIONER

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   General Manager Operations
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B. TARIFF PETITION

1. Introduction

1.1 Lal Pir Power Limited ("Lal Pir" or the "Petitioner" or the "Company") is an independent power producer ("IPP") set up pursuant to the Power Policy of 1994 ("1994 Policy") and is owned by certain companies within the Nishat Group ("NG"), operating primarily in 5 core businesses, namely textile, cement, banking, power generation and insurance. NG has assets of over Rs. 500 billion (US$ 5 billion) and ranks amongst the top five business houses of Pakistan. NG acquired Lal Pir from AES Corporation, USA, which was the main/lead sponsor of the Petitioner.

1.2 NG owns, in addition to Lal Pir, 2 more power plants owned by the companies (within the NG) namely, Pak Gen Power Limited ("Pak Gen"), which is also a 1994 Policy IPP, and Nishat Power Limited, which is set up under the Power Policy of 2002 ("2002 Power Policy").

1.3 The Petitioner set-up a 362 MW (net) project of residual fuel oil ("RFO") after its tariff was agreed and among others, the Basic Documents (defined below) were entered into (collectively, the "Project") under and pursuant to the 1994 Policy before the creation of National Electric Power Regulatory Authority ("NEPRA" or the "Authority") under the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 (the "NEPRA Act"). Accordingly, the Project was effectively "grandfathered" in terms of the jurisdiction of NEPRA, which was established under the NEPRA Act. The Generation License (defined below) has certain special provisions recognizing this status.

1.4 The Petitioner built the Complex, owns and operates it, and supplies electricity to the Power Purchaser under and pursuant to the PPA (defined below). The Petitioner achieved the commercial operations date (the "COD") on 6 November 1997.

1.5 The Petitioner is a licensee (being a holder of the Generation License, defined below) within the meaning of "licensee" as defined in the NEPRA Act, bearing Generation License No. IPGL/06/2003 dated 26 August 2003 (the "Generation License"). A copy of the Generation License is attached herewith as Annexure A, which has all the relevant details of the Generation License.

1.6 Lal Pir entered into an Implementation Agreement dated 24 September 1994 as amended (the "IA") with the Government of Pakistan (the "GOP"), a Power Purchase Agreement dated 3 November 1994 as amended (the "PPA") with the Pakistan Water and Power Development Authority ("WAPDA" or the "Power Purchaser") and the Fuel Supply Agreement dated 6 November 1994 as amended (the "FSA") with the Pakistan State Oil (the "Fuel Supplier"). The IA, the PPA and the FSA hereinafter the "Basic Documents"). Copies of the IA, the PPA and the FSA are attached herewith as Annexure B, Annexure C and Annexure D respectively. Capitalized terms used herein,

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unless defined herein, shall have the meanings ascribed to them in the IA and the PPA.

1.7 The remaining period of the Basic Documents and of the obligation of the Petitioner to supply electricity to the Power Purchaser are thirteen (13) years (the "Remaining Period"), that is up to 2028.

2. Background

2.1 With the rapid rise in oil prices in the last few years, the electricity from the Complex, like all other RFO based IPPs, has become expensive. To give a comparison, the price of RFO was Rs. 2,843.50 per ton when the PPA was signed, while it is today approximately Rs.70,000 per ton; an increase of 24 times. Given the current trend of RFO price rise, the increasing reliance of the GOP on indirect taxation for revenue requirement, and the continued pressure on PKR against other currencies, the fuel component of the Project is likely to continue rising.

2.2 This increasing RFO price is putting drastic impact on the country's economy in the shape of rising circular debt and electricity price. The expensive electricity is making our products less competitive in the international markets.

2.3 The GOP is keenly looking after with the option to convert the existing oil fired power plants on imported coal to cope up with the issue of increasing fuel prices. With the objective to lower the energy cost in the larger interest of Country and business, the Company has decided to replace its existing RFO fired boiler to Coal fired boiler. There will be significant net savings for the Power Purchaser by the Conversion to coal resulting primarily due to cheaper fuel cost.

2.4 The Petitioner received a letter No. 1(103) PPIB/11/PRJ dated 2 May 2011 from the Private Power and Infrastructure Board ("PPIB") for the conversion of existing Complex on a cheaper fuel. A copy of the PPIB letter is attached herewith as Annexure E.

2.5 In July 2013, the Council of Common Interests ("CCI") of the GOP approved the new Energy Policy of 2013 (the "2013 Policy"), envisioned conversion of boiler based power plants operating on RFO over to coal firing (the "Conversion"). Four IPPs, including Lal Pir, fall in the category of Conversion. The Petitioner also signed an MOU with the GOP on 28 June 2013 for the Conversion of the Complex ("MOU"). A copy of the MOU is attached herewith as Annexure F.

2.6 Subsequently, the Economic Coordination Committee ("ECC") of the GOP took up the matter in January 2014, approved the Conversion and directed the companies of these four IPPs, including Lal Pir, to apply to NEPRA for a new coal based tariff on the basis of the Conversion. PPIB's letter dated 29 January 2014 in this regard is attached herewith as Annexure G, which mentioned the ECC directive as follows:

"The Economic Coordination Committee (ECC) of the Cabinet considered the Summary dated 16th December 2013 submitted by Ministry of Water & Power on "Conversion of Independent Power Produces (IPPS) of 2000 MW from Furnace Oil To Coal" and directed Ministry of Water & Power to advise NEPRA to determine the power purchase tariff for the IPPs concerned in accordance with their prescribed procedure within a period of 45 days."

2.7 Pursuant to the above, the Petitioner carried out a detailed feasibility study for the Conversion (the "Feasibility"). A copy of the Feasibility is attached herewith as Annexure H.

2.8 The Petitioner is planning to carry out a detailed Environmental Impact Assessment Study (the "EIA Study") in accordance with the standards and requirements of the World Bank/International Finance Corporation and National Environmental Quality Standards. The EIA Study will be submitted to the Environmental Protection Agency of Punjab ("EPA Punjab") for its approval in due course of time.

2.9 The Petitioner has also acquired additional site (the "Additional Site") for purposes of the Conversion.

2.10 The Petitioner has also agreed with engineering, procurement and construction ("EPC") contractor(s) (the "EPC Contractor") a firm EPC price and the technology and equipment for purposes of the Conversion (the "Conversion Equipment"). A copy of the In-Principle Agreement re EPC is attached herewith as Annexure I.

2.11 In view of the above, the Petitioner is proceeding with this Petition for purposes of the Conversion.

3. Legal Regime

3.1 Since the NEPRA Act was enacted and NEPRA was established after the incorporation of the Company and the establishment of its Project, the Project was, therefore, effectively "grandfathered" in terms of the jurisdiction of NEPRA.

3.2 Accordingly, the tariff of the 1994 Policy IPPs, including the Petitioner's, were agreed with WAPDA before NEPRA was established and, therefore, NEPRA does not issue any "true-ups" or any other notifications in the case of the 1994 Policy IPPs, unlike those implemented under 2002 Policy.

3.3 It is to be noted that several of the 1994 Policy IPP power purchase agreements have been amended, with changes in the outputs, the tariffs, as well as the fuel, and in all cases the matter has been commercially settled between the relevant IPP and WAPDA/GOP without reference to NEPRA, in recognition of the same fact. In 1999, the tariffs for most of the 1994 Policy IPPs were amended, and this was not referred to NEPRA. Subsequently, the Rousch Power Project changed its fuel from RFO to gas, and this included further investment as well, but even its revised tariff was not

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submitted to NEPRA. Instead of NEPRA, Rousch and WAPDA/GOP agreed on and reset the tariff on gas.

3.4 The tariffs of the 1994 Policy IPPs, including the Petitioner, are typical two part tariffs with capacity and energy payments. The capacity payment is then further broken into the Non-Escalable Component ("NEC") and the Escalable Component ("EC"). The NEC is supposed to closely represent debt servicing with heavier payments in the first 12 years and very small nominal amounts after that. With most 1994 Policy IPPs having been in operation more than twelve (12) years, and the Petitioner is in its 17th year of operation, the remaining NEC is now a small nominal number. The total of the remaining NEC and the EC represents the agreement of what the Petitioner is to be paid by the Power Purchaser for its equity investment since the debt portion has been notionally paid off.

3.5 In order to comply with the requirement of obtaining a Generation License under the NEPRA Act, the 1994 Policy IPPs that had come in being before the creation of NEPRA, were asked to apply for generation licenses but certain special provisions were added to these licenses to recognize the pre-existing commercial arrangements. In the case of the Petitioner, such special provisions include Article 2(2) of the Generation License, which reads follows:

> "During the subsistence of the Agreements entered into by the Licensee prior to the enactment of the Act, nothing contained in the Rules or this License shall be applied in a manner which is inconsistent with the Agreements and materially increases the obligations or impairs the rights of the Licensee under the Agreements."

The IA and the PPA, the NEPRA Act, Lal Pir and the Generation License are defined as "Agreements", "Act", "Licensee" and "License" in the Generation License respectively.

3.6 It is pertinent to note that the GOP waived sovereign immunity under the signed Implementation Agreements of the 1994 Policy IPPs, including the Petitioner, in recognition of the fact that these are commercial agreements and it cannot subsequently change applicable laws to the economic detriment of these IPPs despite its sovereign status, without keeping these IPPs economically neutral. The special clause in the Generation License, quoted above, was added in recognition of the same.

3.7 In view of the above, there is sufficient legal basis to argue that coal conversion of the 1994 Policy IPPs does not require tariff determinations by NEPRA but rather a commercial agreement between the IPPs and WAPDA/GOP is required.

3.8 The discussion in the following paras under the heading "Legal Regime" is without prejudice to the above.

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3.9 As per Section 7(3) of the NEPRA Act, the Authority is competent to determine tariffs and is required to recommend the same to the Federal Government for notification. As per Section 7(6) of the NEPRA Act, the Authority is required to, *inter alia*, "protect the interests of consumers and companies providing electric power services in accordance with guidelines ... laid down by the Federal Government". (Emphasis added)

3.10 Section 31(1) of the NEPRA Act provides:

> As soon as may be, but not later than six months from the commencement of this Act, the Authority shall determine and prescribe procedures and standards for determination, modification or revision of rates, charges and terms and conditions for generation of electric power, transmission, interconnection, distribution services and power sales to consumers by licensees and until such procedures and standards are prescribed, the Authority shall determine, modify or revise such rates, charges and terms and conditions in accordance with the directions issued by the Federal Government. (Emphasis added)

3.11 The Authority prescribed the National Electric Power Regulatory Authority (Tariff Standards and Procedures) Rules, 1998 (the "Tariff Rules") for the determination of tariffs. Neither the NEPRA Act nor the Tariff Rules bar a company or a licensee, including the Petitioner, from applying for a new tariff or a modification in its existing tariff, either on the existing technology and/or fuel, or on a new technology and/or fuel. It is a general principle of law that where a statute is clear (such that the NEPRA Act and the Tariff Rules do not bar the determination/modification of tariffs as aforesaid), it should be read as such without any insertion of words therein or deletion of words therefrom.

3.12 The documents attached herewith as Annexure E, Annexure F and Annexure G show, in any case, the direction of the Federal Government *Vis a vis* the Conversion and such direction must be given effect by the Authority. Such a direction will be considered binding on the Authority if no procedure is prescribed by it for cases such as the instant one (see Section 31(1) of the NEPRA Act). At the same time, the treatment of the exiting investment, as per the PPA, guaranteed by the GOP cannot be contravened by NERPA.

3.13 Even otherwise, since the policy decision has been made by CCI for the Conversion, and to operationalize this arrangement, the GOP has directed the IPPs, including the Petitioner, through a decision of the ECC to apply to NEPRA for the Coal Conversion Tariff. Although NEPRA Act gives NEPRA the jurisdiction over the generation, distribution and transmission of electricity in Pakistan, after the 18th Amendment to the Constitution of the Islamic Republic of Pakistan NEPRA reports to the Cabinet Division administratively and is made accountable to CCI.

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3.14 Accordingly, the Petitioner is proceeding in compliance with above mentioned directive, subject to the provisions in Section 4 below and without prejudice to the legal position that NEPRA does not have the jurisdiction on the Coal Conversion Tariff on the 1994 Policy IPPs and the rights of the Petitioner existing, *inter alia*, under the Basic Documents and the existing investment in the Project. To the extent that the Authority protects the existing investment already agreed between WAPDA and Lal Pir in the form of the capacity payments in the existing tariff, and develops a new tariff for the new investment (debt and equity), this will result in a workable solution. All rights of the Petitioner in this regard are hereby expressly reserved.

4 Conversion Parameters

4.1 Once the coal tariff as per this Petition (with or without any change) is given by NEPRA and accepted by the Petitioner (the "Coal Conversion Tariff"), the Amended Generation License (defined below) shall be accepted by the Company and be effective as per para 4.2 below. Upon financial close *vis* a *vis* the Conversion (the "Conversion Financial Close") after the execution of new documents and amendment of existing documents for purposes of the Conversion (the "Conversion Documents"), the Complex will be a coal fired Complex (the "Coal Complex", together with the Coal Conversion Tariff, the Conversion Financial Close, the Conversion Documents, the Additional Site, the Conversion Equipment and the Amended Generation License (defined below), collectively the "Coal Project"), and NEPRA will have jurisdiction over its tariff, but not otherwise.

4.2 The Petitioner is also applying for a conditional amendment in the Generation License considering the Conversion (the "Amended Generation License"). According to this condition, an amendment in the Generation License shall be effective from the acceptance of the Coal Conversion Tariff by the Petitioner, failing which the Amended Generation License shall stand withdrawn and the Generation License, without any amendment in terms of the Amended Generation License, shall stand revived.

4.3 The new investment required for the Conversion shall be treated by NEPRA as a new Coal Project for purpose of the determination of capacity payment to be paid for new debt and equity components to be raised.

4.4 The energy purchase price (coal fuel and variable operation and maintenance ("O&M")), and the capacity payment for fresh investment (e.g. fixed O&M, insurance, debt and equity returns) shall be arrived at by NEPRA as per determination of tariffs for new projects, or use of benchmarks for upfront tariffs for similar projects.

4.5 The existing investment shall be protected for the remainder of the PPA term, in the form of capacity payment after adjusting for the fixed O&M cost that is part of the existing escalable capacity rate, together with its applicable indexations.

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4.6 The provisions of paras 4.1 to 4.5 above are notwithstanding anything contrary contained in this Petition.

5 Coal Type

5.1 The coal to be used for this plant has to be imported sub-bituminous coal. Local lignite coal from Thar is not an option given the distance and high ash and water content in it. Local coal production from other sources is insufficient to meet the daily need for the plant.

5.2 Imported coal has the advantage of high quality, low sulfur and a large supply base from markets like South Africa, Indonesia and Australia. In addition, coal is traded on known global indices like Richards Bay and NewCastle and the establishment of an FOB price to ensure transparency is easy. NEPRA has already issued pricing and indexation mechanism for this. Therefore, contracting for known good quality supply at a transparent price is readily possible.

Coal has to be unloaded and handled at Karachi, and then transported up country 950 km to the Additional Site. Assuming a capacity factor of 85%, the annual requirement would be 930,000 tons of coal per year.

5.3 The Coal Project requires approximately 930,000 ton per annum throughout, for which a fully mechanized unloading system will be provided. The coal unloading system will comprise of un-loader to evacuate the train and conveyor belts to transport coal to the storage yard. The Company is in contact with the Pakistan Railways and other third parties to find a reliable source of transportation coal to the Additional Site. The Company will share the same with NEPRA as soon as it finalizes this transportation matter for incorporation in the final numbers.

5.4 Based on the above, the Conversion is planned on imported coal specifications.

6 Coal Source

6.1 The Petitioner expects to source coal at a reasonable delivered cost from Australia, Indonesia and South Africa which are the major coal exporting countries. The total reserves of these three countries account for almost 60% of the worldwide hard coal.

World Top Coal Exporters (2012)

Country	Coal Exports (Million Tons)
Indonesia	383
Australia	301
Russia	134
USA	114
Columbia	82
South Africa	74
Canada	35

* Source: World Coal Association

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6.2 The Petitioner will start the process of identification of the potential sources of coal and its suppliers immediately after approval of the Coal Tariff. For this purpose, the Petitioner shall solicit proposals from a number of internationally renowned coal suppliers. After that the Petitioner shall carry out a detailed due diligence in order to identify the most suitable coal suppliers with regard to geographical location, creditworthiness, available coal reserves and experience in supply of coal in large quantities.

6.3 Coal procurement would be set in a manner to achieve minimum procurement costs while maximizing supply reliability for entire term of the PPA. Sourcing would be distributed among the existing three major supplying countries.

6.4 Our surveys of the international coal market and global experience suggest to adopting a strategy of entering into a mix of short (one year), medium term (up to five years) and long term (greater than 5 years) contracts. It is pertinent to note that due to volatility of the coal market and change in mining asset properties over the period, accessibility to long term Coal Supply Agreement ("CSA") is limited. However, the Petitioner will undertake best efforts to procure longer term CSA to the extent possible at economically viable terms. The contracts will be with a mix of suppliers; coal traders as well as miners; so as to take advantage of long term secure and well identified sourcing along with addressing the need for supply security constraints better serviced by multi source traders less exposed to short term supply bottlenecks. This will guarantee long term reliability of coal supply at competitive fuel costs.

6.5 Generally, imported coal-based projects procure coal through short to medium term contracts. This short to medium termed contracts would also give flexibility to the power producer of effectively managing coal supply and its associated risk through diversified portfolio of reputable international coal suppliers. The Company will enter into a number of CSAs during the Coal Project life which will be renewed through a transparent manner as per international best practices and consistent with the terms of the PPA. The Company will use its experience as one of the largest group in the country.

6.6 Global coal trade is regulated through various liquid coal indices. These indices are published regularly by international companies and followed worldwide. The indices are based on actual transactions in the market and form benchmark for different short to medium term coal contracts. Based on its experience and after consultation with the coal suppliers, the Company has proposed API 4 (Richards Bay) index, which covers FOB coal supply from Richards Bay, South Africa, and Global Coal Newcastle, which covers FOB coal exports from Australia to be used for indexation/price adjustment of the Coal Price. Indonesia is relatively a newer exporter therefore it does not have an internationally recognized coal index. Most of the Indonesian coal supply contracts follow Global Coal and other Australian coal indices. Both these indices are most commonly used and are a transparent indication of price adjustments. NEPRA has already issued pricing and indexation mechanism for this. Therefore, contracting for known good quality supply at a transparent price is readily possible.

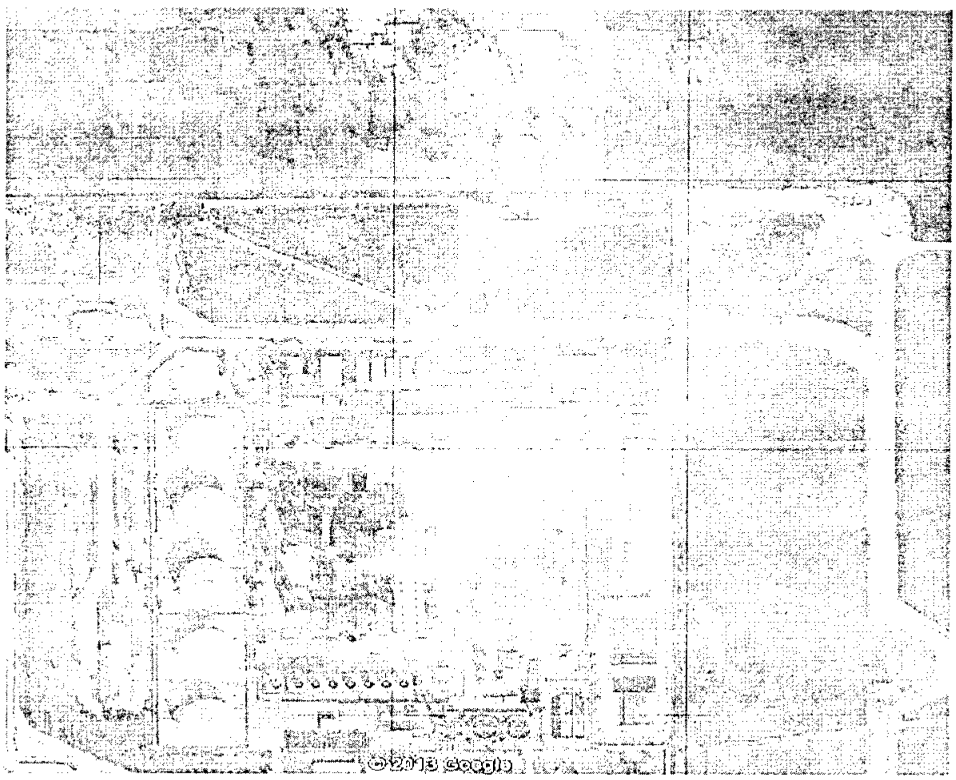
7 Secondary Fuel and/or Backup Fuel

7.1 The Coal Complex will not have any secondary or backup fuel. However, diesel fuel will be used for start-up purposes as it is standard in such plants. The auxiliaries of the Complex can and/or the Coal Complex will use electricity generated on coal.

8 Additional Site

8.1 The Complex is located in southern Punjab region of Punjab Province, Pakistan near District MuzaffarGarh which is approximately 70 km from Multan.

The Site longitude: 70° 59' 35" E, latitude: 30° 10' 23" N and altitude: 117 Meters



**Map is not according to scale*

8.2 The Additional Site is adjacent to the Site. The Additional Site will have all the benefits which the Site is enjoying, such as:

a) cooling water facility and suitability for the construction of intake/outfall structures,

b) availability of canal and good quality well water,

c) road infrastructure, and

d) suitable topographic/geological conditions,

which will minimize the cost of development of the Additional Site and will have less socio-economic and environment implications, such as displacements, availability of ash disposal area and air/noise pollution.

8.3 The Site and the Additional Site will include the following for purposes of the Conversion:

Sub critical boiler	Ash disposal area
Switch gear rooms	Coal stacking area
Ash disposal area	Coal unloading facility
Additional houses in residential community	New stores
Additional equipment required for Coal Complex	Workshop

Existing RFO based boiler is hooked up with a Steam Turbine having following major parameters;

Steam Turbine inlet Temp.: 541 °C
Steam Turbine inlet Pressure: 169 kg/cm2

The above technology parameters can only be complimented with the sub critical coal boiler rather than a super critical boiler. This is worth mentioning that under our proposed arrangement, only boiler and its associated ancillaries will be replaced for conversion to coal firing project, whereas, steam turbine & generator would not be replaced. Super critical technology can only be used if complete revamping of the existing plant including turbine/generator and its auxiliaries is done which is not an economical solution. This would practically be constructing a new plant at the existing site. Hence, to keep the project viable as compared to new coal projects, only oil fired boiler will be replaced with coal fired sub critical boiler. Compete details of various alternatives and their considerations are shared below;

The Company explored two alternatives for potential conversion, in consultation with CDF of France (Technical Consultant).

a) Demolish the existing boiler and reconstruct the new boiler in place of the old one.
b) Build the new boiler in an open field near the existing boiler room. Demolish the existing one as soon as the new boiler is in operation.

Alternative I):

The main disadvantage of this Alternative is the loss of very important operational period and complexities involved with dismantling and clearance. The down time for this alternative could exceed three years. First, we had to dismantle the existing equipment which will be replaced and when soils are remediated (soil clean up performed), construct the new boiler. We estimated the first phase for 6 months and 2.5 years for reconstruction of new boiler. However, the advantage is that the new boiler will not experience a loss in steam pressure. The steam piping network is optimized.

Alternative II):

The main advantage of this alternative is to minimize the downtime and avoid a significant loss of production. The outage corresponds to:

- The connections of steam pipes, feed water and other fluids
- Replacement of existing equipment to match with new project life, either due to limitation of equipment life cycle and/or their under sizing in the new configuration,
- Adaptation of the monitoring and control of the new boiler in line with the driving equipment of the turbine and its auxiliaries,
- Commissioning of new equipment, testing and verification of security.
- A disadvantage of this alternative is to remove the boiler from the existing place and greatly increase the length of steam and feed water piping Connection. The consequences of this separation are:
    - increase the price of water steam piping,
    - increase heat loss related to pipelines,
    - increase the pressure drop of the same pipe network with the effect of increasing the consumption of feed water pumps motors,
    - modify the conditions of the admission steam turbine IP.

According to the above analysis (conversion of existing boiler and integration of subcritical boiler), keeping in view the existing unit age / condition, The Company is very confident that the implementation of new subcritical coal fired boiler with alternate (II) would be the most viable solution. This solution had been finally verified by the consultant and subsequently confirmed by all EPC bidders. Further details of this alternative are evaluated by the consultant in the feasibility study attached with the petition.

Already installed existing equipment of the Complex to be used for the Coal Complex, includes;

362 MW Turbine	Turbine hall
Hydrogen Plant	Electrical switch yard
Switch gear rooms	Central control room
Administration building	Miscellaneous pump houses
Circulating pump structure	Water treatment building
Workshop	Stores
	Residential community

The proposed retrofitting site contains three main areas; the main power building area, the dusting area, the coal yard area.

New Boilers will be constructed on the West side of the power plant (dismantling of HFO tank 2 to 4 in particular). Coal bunker bay, boiler, are arranged from the east to the west. The central building and air compressor room are arranged between the two boilers.

The dusting area is next to the boilers. E.S.P, I.D FANS, chimney, absorbing tower are arranged from the east to the west. Fly ash silo, desulfurization complex building, emergency slurry tank, limestone storage shed are arranged at the north direction of the chimney.

The coal yard area will be located on the north side of the plant. There are coal yard, weighbridge, coal contained wastewater treatment station, coal yard rainwater settling pond, coal yard spray water pond, proposed in this area. The coal will be transported to the coal bunker bay by the coal handing conveyer. The railway link will be arranged on the east side of the plant.

The workshop and ware house are proposed on the north side of the boiler. Domestic sewage water treatment station, domestic and firefighting water pond, domestic and firefighting water pump house, water drainage pump house, rain water reclaimed treatment station are arranged at the south direction of the ash yard.

Some existing facilities are proposed to be demolished / moved. The buildings and structures which are on the route of the coal handing conveyer will be demolished or moved.

9 Bids Evaluation Process:

9.1 Complete process of bids evaluation followed by the company is shared below. The Company engaged Technical Consultants M/S CDF of France to carry out the activity, who prepared detailed RFP "Request for Proposals" of project and shared with potential EPC bidders. The Company followed the below process for this activity:

a) Detailed feasibility study of coal conversion project along with coal transportation arrangements by CDF
b) Preparation of request for proposal "RFP"
c) Sharing of RFP among potential EPC bidders; (1). Mitsubishi heavy Industries (MHI) Japan – OEM of company (2). Shanghai Electric Corporation, China (3). HARBIN Industries China.
d) After site visit & clarifications of RFP information, bidders submitted their proposals as per stipulated timeline.
e) Evaluation of EPC bids carried out by M/S CDF France
f) Preparation of final summary table along with conclusion by CDF France.

9.2 Below is the brief scope of work given by the company in the EPC for the conversion of existing boiler:

- Installation of the associated coal unloading, storage and coal feeding system.
- The ash handling, storage and disposal systems.
- All related civil, mechanical, electrical and HVAC works and the necessary instrumentation.
- The resolution of all interface and interconnection matters to tie in the new boilers with the existing plants, with its integration in the existing MHI turbines of same capacity, its integration in the existing plant control systems and the plant electrical systems etc.

- The proposed new boiler shall be of the latest and proven technology. It is designed for a minimum of 30 years of design life time, applying best engineering practices from the perspective for operation, maintenance and should have world class performance, to be environmental friendly and to maintain high reliability, availability in their configuration, equipment lay-out, control systems and so forth.
- The scope of supply and of the services shall likewise include all elements necessary in order to ensure that the units and all systems and equipments supplied can be operated and maintained throughout the entire range of environmental and operational conditions.
- The scope of supply shall therefore include planning, design, engineering, project management, procurement of equipment and materials, manufacture, construction including labour supervision, temporary facilities and services, and construction equipment, tools and consumables, erection & installation, international and local transportation.
- Any temporary works to public highway or facilities require to facilitate transport of equipment and material to site including, reinstatement fees, and compensation, etc... for any disturbances and permits for material movements, testing, quality inspections, initial start-up, tests, inspections for commissioning, Vendor or Supplier assistance and inspection acceptance, functional testing (reliability run), personnel training, documentation and any other supply or service additionally necessary to achieve realization, by way of a "turnkey"-type contractual agreement, of the aforementioned new power plants.

9.3 The Company invited three well known international companies of repute who visited the plant to determine their interest in offering coal conversion proposals.

9.4 Out of these three potential bidders, OEM MHI Japan didn't submit a complete proposal in line with the RFP requirements and just shared a budgetary proposal. The Company pushed MHI to submit detailed proposal but it seem that MHI had little appetite and were concerned about the uncertainties associated with the whole process including regulatory framework. As MHI quote was significantly higher than the other two bidders, the Company didn't pursue MHI further. Other two EPC bidders i.e. SEC & Harbin china submitted complete proposal for this conversion project.

9.5 Budgetary quotation of MHI was US$ 375 million per project excluding demolishing & coal handling system with 41 months project time. Due to their significantly higher numbers and lack of appetite, MHI was dropped in initial screening. Discussions and meetings both in China and in Pakistan remained in process with the other two bidders which included visit of both companies facilities in China.

9.6 A brief technical comparative data of these two bidders is included below;

Description	units	SEC	HARBIN (HEI)
Superheated steam outlet flow	t/h	1190	1185
Superheated steam outlet pressure	Kg/cm²g (bar(a))	178.5 (176)	178.4 (176)
Superheated steam outlet temperature	°C	541	541
Feed water temperature	°C	Not indicated	283.3
Reheat steam outlet flow	t/h	1197.9	978
Reheat steam inlet pressure	Kg/cm²g (bar(a))	38,5 (39)	41.3 (41.5)
Reheat steam outlet pressure	Kg/cm²g	36.5	38.3

	(bar(a))	(36,8)	(38.6)
Reheat steam outlet temperature	°C	541	541
Reheat steam inlet temperature	°C	332	337.8
Boiler Efficiency	%	88.5	89%

9.7 A brief price comparison summary of the two bidders :

Description	SEC	HARBIN (HEI)
Boilers and direct auxiliaries (primary & secondary air fans, ID Fans, coal silo, mills, PC distribution circuit, HSD distribution circuit, burners, bottom ash extraction, sampling and chemical dosing, piping rack):	US$ 141 MM	US$ 137 MM
Coal unloading, storage and handling /ash handling and storage:	US$ 52 MM	US$ 60 MM
Electricity and I&C:	US$ 29 MM	US$ 26 MM
Flue gas treatment to reach environmental requirements:	US$ 32 MM	US$ 28 MM
Contingency :	US$ 5 MM	US$ 5 MM
Total:	**US$ 259 MM**	**US$ 256 MM**

9.8 SEC and HEI provided a complete proposal in line with the RFP along with a set of preliminary drawings / documents. Both companies have presented quite similar technical offers, based on technical specifications. A slight advantage can be given to HEI offer because of a better net thermal efficiency of boilers i.e. 0.50% and lesser cost cost as compared to the SEC. In addition, Harbin team was more impressive in their understanding of technical / commercial matters.

9.9 Based on above comparison, the Company chose HARBIN China to carry on further discussions. HEI in particular presents advantages technically and economically.

9.10 Hence, the Company negotiated further with Harbin and agreed upon at US$ 248 MM as final price. Final breakup of broad heads;

Description	HARBIN
Boilers and direct auxiliaries (primary & secondary air fans, ID Fans, coal silo, mills, PC distribution circuit, HSD distribution circuit, burners, bottom ash extraction, sampling and chemical dosing, piping rack):	US$ 135 MM
Coal unloading, storage and handling /ash handling and storage:	US$ 58 MM
Electricity and I&C:	US$ 25 MM
Flue gas treatment to reach environmental requirements:	US$ 25 MM
Contingency :	US$ 5 MM
Total:	**US$ 248 MM**

10 Coal Complex Basic Benefits and Objectives

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10.1 Based on the Feasibility, the total gross capacity of the Coal Complex after the Conversion will remain same, that is 362 MW (gross, ISO) but the net capacity will drop to 329.42 MW (net) because of higher auxiliary consumption.

10.2 The conventional method for generating electricity from coal is to burn it in a thermal power plant, which will generate steam for power generation. Depending on the steam pressure of existing system, a coal based sub critical boiler (the "Coal Boiler") will replace the existing RFO fired boiler. The steam quality will be the same as of exiting steam produced by the RFO fired boiler.

The Company has selected the PC sub critical technology Coal Boiler that can replace the existing RFO boiler. The Company had considered the option of using Super Critical technology. However, it was ruled out due to the limitation with existing Turbine parameters and other auxiliaries which will not be replaced along with the boiler. Hence, as a most viable option, Company has opted to pursue the proposed structure.

10.3 The Coal Boiler will be designed, manufactured and erected as per internationally accepted practices by adhering to the relevant or equivalent American Society of Mechanical Engineering's Standards. The Coal Complex's estimated key performance data and energy balance is set out below.

Approximate Auxiliary Load per Unit	32.58 MW
Gross Heat Rate	8,724 Btu/ kWh
Net Heat Rate	9,587 BTU/kWh (LHV)
Gross Efficiency	39.1%
Net Efficiency	35.6 % (LHV)
Capacity Factor	85 %
Design coal LHV	25,555.98 BTU/kg
Coal Consumption	930,000 tons pa at 85% capacity Factor
Auxiliary Load:	9% of gross load after coal conversion

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Specification, Make & Model of new Boiler and Existing Turbine Efficiency:

Make	Harbin China
Capacity	1,185 t/h
Pressure at super heater outlet	17.5 MPa
Pressure at re heater inlet	4.052 MPa
Pressure at re heater outlet	3.856 MPa
Temperature at super heater outlet	541 oC
Temperature at re heater inlet	337.8 oC
Temperature at re heater outlet	541 oC
Feed Water Temperature	283.3 oC
Flue gas temperature after ESP	131.65 oC
Boiler Efficiency	89%
Existing Turbine Efficiency:	43.94%

The actual Coal Complex gross, net, auxiliary load and efficiency numbers would be adjusted in accordance with the final EPC contract to be executed between the Company and the EPC Contractor. Similarly, the coal CV will be true up as per the actual coal supply agreement which is expected to be less than 25,555.98 BTU/kg, (as per coal upfront tariff). Final tariff adjustment & plant efficiency numbers would be based on actual coal LHV based CV. This would be adjusted at the time of final coal supply agreement with coal suppliers.

The plant net efficiency approved for 350 MW plant in upfront tariff is 39% with 9% auxiliary load. However, in this conversion project only boiler will be replaced and expected that auxiliary load will increase up to 9.0%. Due to this increase in auxiliary load and replacement of boiler, net plant efficiency will reduce to 35.6 %. Plant's average efficiency on RFO is around 37%. However, even with this decrease in efficiency due to less project investment as compared to new coal plant and generation of electricity on RFO, unit cost from this conversion project would be even less than new coal projects.

The power will be supplied to NPCC *via* 220 KV existing grid connections.

10.4 Operation and maintenance philosophy for the Coal Complex would be to maximize safety, maintain high efficiency and minimize costs in that order. As stated above, Company has vast experience to run this facility. The Coal Project operations and maintenance services will be provided by a dedicated O&M team.

10.5 The Project is based on coal which shall be the most economical fuel for thermal power generation in Pakistan at the most competitive average tariff of 7.1780 Rs/kWh (7.3924 cents/kWh). This includes the capacity payment for existing Complex for the remaining life of existing PPA. The Coal Project will be the key in overcoming the current increase in electricity price.

The proposed tariff of the Coal Project would be 7.3924 cents/kWh. This will significantly reduce the average cost of generation of the Power Purchaser and provide cheap electricity to the consumers.

10.6 The Coal Project is conceived as a means to balance the energy mix in Pakistan and as a solution to reduce the reliance on imported oil and thereby address the prevailing growing deficit of electricity in Pakistan. This Coal Project would also help in overcoming the shortage of electricity in the winter months, which is due to fuel shortage rather than capacity constraints. 41% of the world's electricity is produced through coal, whereas, in Pakistan coal is not used for power generation. China is the largest coal producer in the world and has recently become a net importer of coal and 65% of their total generation is based on coal. The percentage of power produced from coal worldwide as compared to Pakistan is tabulated herein below:

Electric generation fuel	World – %	*Pakistan – %	Variance – %
Coal	41	0.0	(41)
Gas	20	26	6
Hydro	16	31	15
Nuclear	15	6	(9)
Oil	6	37	(31)
Other	2	0	(2)
	100	**100**	

Source: World Coal Institute & Causes & Impact of Power Circular Debt by Planning Commission of Pakistan in March 2013

10.7 The Coal Project would be one of the largest thermal power plants in Pakistan which would bring significant investment and provide large scale solution to the current increasing electricity prices.

10.8 The Coal Project will have a Net Dependable Capacity (NDC) of 329.42 MW consisting of 1 x 329.42 MW (net) coal-burning unit. The Petitioner would use state of the art efficient and reliable technology for the Conversion which would include the Coal Boilers ensuring the best possible and environment friendly plant performance adhering to international standards.

10.9 The Coal Project would offer more than 1,500 jobs during the construction phase and over 50 new jobs during the operation phase. In addition to social contributions on account of health and education, the Coal Project would provide state-of-the-art training of operating coal-fired plants to local workforce which will help in developing indigenous coal projects in Pakistan.

10.10 Based on NG's experience of operating financial institutions and developing large scale projects in different sectors and considering the scale of funding required for the Coal Project, participation of at least 3-4 bilateral and/or multilateral lending agencies appears to be a must. The Company has already explored initial interest with the some Chinese and local banks. In addition to these, we expect to tap Japanese, Chinese or European bilateral lending institutions as we finalize a partnering and/or EPC strategy.

11 Construction Schedule

11.1 The Coal Project is expected to be completed in 36 months after the Conversion Financial Close. However, this construction period will be firmed up upon approval of the Coal Tariff.

11.2 A coal boiler is larger than a RFO boiler for similar output for the standard coal type being considered. When you add the coal feeding system and ash removal system, which are both extensions of the boiler, and add environmental compliance equipment, the space requirement goes up significantly compared to the footprint of the existing RFO boiler.

11.3 Further, if the new boiler is placed at the same location, even if space consideration did not exist, the Complex would have to be shut down for almost two years, to first remove the existing boiler and then install a new one at the same location. This period will result a lot of additional fixed costs, as well as unavailability of the plant for an extended period.

11.4 In light of the above, it has been decided that, initially the existing boiler will not be dismantled until completion of new boiler .A new boiler will be built at another location nearby. The feed-water lines going into the existing boiler and the steam lines coming out of the boiler and going into the turbine will be cut off and redirected to the new boiler area..

11.5 With this program, the new boiler can be erected in about 30 months until it is ready, while existing Complex continues to operate on RFO. The Complex will shut down for only about 6 months at the end for new steam lines, feed water lines, instrumentation of the new boiler.

12 COAL PROJECT FINANCIALS

12.1 Capital Structure

The capital structure of the Coal Project is outlined as follows:

	Million (USD)
Equity	72.09
Debt	216.26
Project Cost	288.35
Debt : Equity Ratio	75:25

12.2 Project Cost

The break-up of the Coal Project cost is summarized as follows:

	Million (USD)	Million (USD)
EPC Costs:		
EPC Cost – Plant*	248	
		248
Other costs:		
Land & Land development	4	
Development & Construction Management	10	
		14
Financing, Taxes and Insurance Costs:		
Custom Duties	--	
Financing Charges	13.76	
Interest During Construction	12.6	
		26.35
Total Project Cost**		**288.35**

** 0.7965 Million USD/MW including financing and other costs

12.3 EPC Costs

For the purposes of this Petition, the Company has at this stage relied upon the EPC costs and the performance parameters as per the EPC In-Principle Agreement.

a) The EPC cost is a lump sum cost and includes the cost of new boiler and coal handling system together with all the necessary auxiliary machinery, equipment and systems including the erection and commissioning of the equipment and construction of buildings. Below is detailed breakup of the EPC Cost of USD 248 Million,

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Boilers and direct auxiliaries (primary & secondary air fans, ID Fans, coal silo, mills, PC distribution circuit, HSD distribution circuit, burners, bottom ash extraction, sampling and chemical dosing, piping rack):	US$ 135 MM
Coal unloading, storage and handling /ash handling and storage:	US$ 58 MM
Electricity and I&C:	US$ 25 MM
Flue gas treatment to reach environmental requirements (if required):	US$ 25 MM
Contingency :	US$ 5 MM
Total	**US$ 248 MM**

b) The Company has provided a firm EPC price. However, if any price is changed due to any delay in the approval of the Coal Tariff, the Company shall request the Authority to adjust the Tariff Ruling.

c) Flue gas treatment cost is added as an option. Since the Company intends to use imported coal for the conversion project, a Flue Gas De-sulfurization (FGD) unit along with its auxiliaries is proposed be included as a part of the total Project Cost. The Company should be able to meet the Punjab Environment Protection Agency's NEQs without adding the FGD. However, foreign multilateral financial institutions may require the project to follow the prevailing World Bank guidelines in addition to the local NEQs. These stringent requirements may require installing FGD system to make emissions in accordance with the World Bank guidelines and the local NEQs. The Company has proposed the FGD system as an option in case the foreign financial institutions require the Project to meet more stringent guidelines. The Company would remove the cost of FGD from its proposed total Project Cost in case FGD is not required to meet the relevant environmental guidelines. We have proposed the cost of FGD as a separate line item in our proposed Project Cost and the In Principle EPC Contract.

12.4 Land and Land Development Costs

The Company has already purchased Additional Site for the Conversion Project. The land and development cost will include (a) the cost of new purchased land (b) the cost of backfilling and leveling of the Additional Site, (c) construction of the boundary wall and watch towers, (d) widening and improvement of the access road of approximately 3-4 kilometers to enable heavy construction machinery and power plant movement, and (e) construction of additional housing for new employees.

Land & Land Development Cost		
	Rs	USD
New Land	50,000,000	514,933
backfilling & Leveling of land	14,000,000	144,181
Boundary wall	20,000,000	205,973
Road Widening	55,000,000	566,426

Additional Housing	250,000,000	2,574,665
Total	**389,000,000**	**4,006,179**
	Million USD	**4.0**

	Development & Construction Management Cost	
	Rs	USD
Feasibility Study, EIA etc.	50,000,000	514,933
Consultants	175,000,000	1,802,266
Financial Advisors	50,000,000	514,933
Office expenses	66,000,000	679,712
Bank Charges for guarantees	20,000,000	205,973
Fee for licenses & permits	10,000,000	102,987
Construction Management cost	600,000,000	6,179,197
	971,000,000	**10,000,000**
	Million USD	**10.0**

12.5 Development and Construction Management Costs

The Coal Project will be the first coal conversion project in the Country. Arranging a non-recourse financing in the current global economic scenario would also be very challenging. The Coal Project would, therefore, require a team of experts and consultants to structure and develop the Coal Project, the security package and the financing package in line with internationally acceptable standards.

The development costs include costs incurred so far and to be incurred till Conversion Financial Close of the Coal Project. This mainly comprises of (a) the cost of Feasibility and other studies like site selection, EIA study etc. (b) fees of technical, coal and legal consultants (local and foreign for both the lenders and the Company), (c) financial advisors and arrangers, (d) office expenses including traveling and remuneration of the Coal Project development team (e) bank charges for guarantees and (f) fees for licenses and permits.

The construction management costs would be incurred over a period of 36 months till the Conversion COD. These primarily include (a) the fees and expenses payable to the independent engineer in accordance with the PPA pertaining to the construction management and supervision costs, (b) lenders' engineer and other advisors costs, (c) all administrative costs including remuneration and traveling of the construction management team incurred from the Conversion Financial Close of the Coal Project until the Conversion COD.

12.6 Duties

Custom duties are not included at this stage. This will be adjusted as per actual at later stage after signing of detailed EPC contract and based on custom duties of respective machinery.

12.7 Financing Fees and Charges

This includes the front-end Fee and commitment fee for the requisite debt for the Coal Project. These fees and charges are assumed at 7 % of the debt amount, which will be adjusted at Conversion COD as per actual. In case the Petitioner obtains local funding and/or the financing fees and charges in respect of foreign loans exceed the assumed number, the ceiling of 5% will be applicable to such financing fees and charges. Below is the calculation of Financial Charges of USD 13.76 M

Capex		Million USD	262
Debt Amount(75% of total Capex)	a	Million USD	196.50
Financing Fee(% of Debt Amount)	b		7.00%
Financial Charges Total	a*b	Million USD	13.76

12.8 **Interest During Construction**

It has been calculated on the basis of payment schedules in terms of the EPC contract keeping in view the equity and debt injections together with the applicable interest/mark up rates. Calculation of interest during construction (IDC) is given in Annexure K attached herewith

13 TARIFF SUMMARY

13.1 Based on the EPC In-Principle Agreement (attached as Annexure I) and the Coal Project cost, the Company has prepared this Tariff Summary.

13.2 The tariff has a typical two-part structure with an Energy Charge ("EC") for the energy actually dispatched and a Capacity Charge ("CC") based on the available capacity. The Energy Charge is based on the actual kWh off-take, and consists of the fuel component and the variable O&M component.

13.3 The proposed tariff figures appended herein below are the result of a detailed techno-financial analysis. The levelized tariff is based on a notional 85% plant factor as per the 2014 upfront coal tariff for new coal plants and a 25-years PPA term on a Build Own and Operate (BOO) basis.

13.4 These numbers are based on the general assumptions detailed in Section 13 below and elsewhere in the Petition.

	CC*	EC	Total Tariff	
	Cents/kWh	Cents/kWh	Cents/kWh	PKR/kWh
Average Tariff	(2.0715)	(5.3209)	(7.3924)	(7.1780)
Levelized Tariff	(2.6509)	(5.3209)	(7.9718)	(7.7406)

*CC is calculated at 85% plant factor

** This Capacity Charge includes the Capacity Payment of existing Complex (that will be applicable till completion of 30 years of original PPA i.e. March 2028)

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A Reference Tariff Table along with the comparative table of Existing Tariff and Proposed Tariff are attached herewith as Annexure J.

13.5 Energy Charges

The Energy Charge of the reference tariff is based on the actual net electrical output measured in kWh and consists of:

a) Fuel Cost Component ("FCC")
b) Variable Operation and Maintenance ("O&M") Component (Local and Foreign)

A summary of the levelized Energy Charge is provided in the table below followed by detailed explanation of each item:

	Fuel Cost Component	Ash Disposal Charges	Lime Stone	Variable O&M (Local)	Variable O&M (Foreign)	Total Energy Charges
Tariff (cents/kWh)	4.8416	0.2266	0.0927	0.0960	0.0640	5.3209

a) Fuel Cost Component

i. This component represents the coal consumption at a guaranteed efficiency level at 100% plant load factor. The main assumptions are as follows:

Output	329.42 MW (net at reference Site conditions)
Calorific Value	25,555.98 Btu/Kg (Net) subject to adjustment at the time of finalization of CSA and EPC Contractor recommendations
Heat Rate	9,587 BTU/kWh (LHV) at 100% plant capacity factor
Thermal efficiency net	35.6% (at reference Site conditions) at 100% plant load factor
Coal Price (CP)	USD 129.06 per ton as per approved upfront tariff for imported coal, subject to adjustment as per formula mentioned herein. No import duties/ taxes have been included in the cost of coal and shall be treated as part of the Coal Price if levied. This doesn't include coal transportation cost at project site. It would be true up based on finalization of coal transportation mechanism.
Coal Freight (CF)	Coal transportation cost will be added after finalization of coal transportation agreement (Karachi Port to Additional Site). This shall include the cost of coal transportation and shall be treated as part of the Coal Freight, if levied.
Partial Loading	Heat rate curves from the EPC Contractor to be used for partial load heat rate calculation and payment.

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Annual Degradation	Annual Degradation will be adjusted in Heat Rate based on the data provided by the EPC Contractor and OEM

The adjustment factor in coal price and coal transportation shall be finalized after finalizing the CSA.

ii. The Company is in contact with Pakistan Railways and some other private companies to establish the arrangement of coal transportation from Karachi Port to the Additional Site. The contract for transportation of coal within the Country will be finalized after following the open competitive bidding process. Once we finalize this arrangement based on economical and reliable basis, coal price can be adjusted accordingly.

iii. Fuel Cost Component indexed to coal price instead of RFO, with HHV-LHV adjustment, on a BTU basis, using the NewCastle index and the freight and handling charges being actual. The commodity pricing needs to be adjustable to actual BTU content.

The Fuel Cost Component shall be adjusted in accordance with price variation of fuel consumed using international coal price indices. The coal freight and the coal premium/discount will be charged as actual but will be subject to a transparent tendering process with the coal suppliers and the shipping companies. The FCC will be subject to foreign exchange adjustment, load correction and heat rate degradation factor.

b) Variable O&M Component

i. This component primarily includes the cost of lubricant consumption, chemicals, consumables, fuel for coal and ash handling including stacking, piling, blending, minor maintenances, checks and inspections related to load variations. This component also includes the maintenance cost of conveyors, gantry crane maintenance, coal unloading system lubrications. The Petitioner estimates 50% of total variable cost as local. The variable O&M is calculated based on existing O&M to run the Complex. Since the company is going to replace only the boiler while remaining major equipment for 362 MW plant like turbine, condenser, Balance of plant, and hydrogen system will be reused, the company is adopting the existing O&M cost for the post conversion coal tariff . Therefore, O&M Cost of the plant will not change from existing level hence the company claiming existing VOM. Please note that this will not increase the tariff and not put any impact on overall electricity price. Variable O&M for existing Complex is Rs. 0.03/kWh at the time of the present PPA. That has now increased to 0.155 after indexation. The Petitioner requested for the same Variable O&M after the Conversion.

ii. The Petitioner used ash removal & lime stone charges as per coal upfront tariff.

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iii. The Local Variable O&M (**LVOM**) Cost Component, ash removal and limestone charges of the Energy Charge shall be quarterly indexed to the Pakistan Wholesale Price Index ("**WPI**") (manufacturing), as notified by the Pakistan Federal Bureau of Statistics.

iv. The Foreign Variable O&M (**FVOM**) Cost Component of the Energy Charge shall be quarterly indexed to both:

1) the USD/PKR exchange rate, based on the revised TT & OD selling rate of USD notified by the National Bank of Pakistan; and

2) US CPI, published by International Financial Statistics

13.6 Capacity Charge

The Capacity Charge component of the reference tariff is payable on the basis of the contract capacity established at the Conversion COD and annually thereafter. This payment is calculated on a basis of 329.42 MW capacity (net, at reference site condition) and in order to calculate a levelized unit rate at a notional 85% plant factor.

The Capacity Charge is composed of (a) Escalable Component, (b) Escalable Component of Existing Capacity Payment and (c) Non- Escalable Component. A detailed breakup and explanation of these components is provided below.

a) **Escalable Component**

This component represents (i) Insurance cost, (ii) Fixed O&M cost (Foreign and Local), and (iii) Return on Equity ("ROE"). The Levelized tariff for the Escalable Component is tabulated below:

	Insurance	FO&M Local	FO&M Foreign	ROE	Total @ 100% CF	Total @ 85% CF
Tariff (cents/kWh)	(0.0814)	(0.0665)	(0.0665)	(0.6146)	(0.8289)	(0.9752)

Calculation of ROE	units		
Annual net generation at 100%	kwh	(a)	2,885,719,200
Project development costs			
CAPEX	Million USD		262.00
Financial Charges			
Financial fee and charges	Million USD	13.76	
Interest during construction	Million USD	12.60	26.36

Total Project Cost	Million USD		288.36
Exchange Rate per USD	Rs.		97.1
Financial Plan			
Debt foreign	Million USD	75%	216.27
Equity	Million USD	25%	72.09
Equity	Million Rs.		6,999.82
Return on Equity	%		24.5%
Project life	Yrs.	25	
ROE	Rs. ANNUAL	(b)	1,722,147,099
	Rs./kwh	(b/a)	0.5968
	Cents/kwh		0.6146

i. **Insurance**

The insurance component consists of all-risk insurance/re-insurance for the Coal Project, as well as business-interruption insurance.
The insurance costs shall remain within the threshold of 1.00% of 70 % of EPC Price of new installed equipment while the insurance of existing plant is covered by the existing escalable component.

To adjust the insurance of existing plant, the petitioner used insurance Rs. 0.1152/kWh as approved by NEPRA for 350 MW coal power plants after the completion of existing PPA (i.e. March 2028).

The Insurance cost component shall be quarterly indexed to both:

1) the USD/PKR exchange rate, based on the revised TT & OD selling rate of USD notified by the National Bank of Pakistan; and

2) US CPI, published by International Financial Statistics.

ii. **Fixed O&M**

1) Fixed O&M till the completion of existing PPA.

2) The Fixed O&M component primarily represents the (a) salaries of additional (new hired employees) and (b) budget for the maintenance of new boiler and coal handling system including annual and scheduled outages.

All other fixed O&M components are also covered by the Escalable component which belongs to existing PPA. This part is applicable till the completion of existing PPA i.e. 2028. Post 2028 (after the end of the existing PPA tenor), the Company has adopted the fixed O&M as

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approved by the NEPRA for 350 MW plant. However, till the expiry of existing PPA (2028), the Company claimed additional fixed O&M cost which is only associated with the coal boiler along with the salaries associated with the new employees for additional systems.

3) It is assumed that 50% of the Fixed O&M component will be local.

4) The routine maintenance costs would be incurred on all major equipment of the Coal Complex and coal area. Major maintenance will be carried out after every four years. The cost for routine maintenance of existing plant is not added in this tariff; this would be taken from capacity payment of existing plant.

Fixed O&M after the completion of existing Contract:

5) The fixed O&M component after the completion of existing contract (i.e. March 2028) of whole plant will represent the (a) Routine & Major Maintenances, (b) fixed costs of all the staff for Operation and Maintenance, (c) Material Handling costs, (d) Operation & Maintenance costs relating to the coal handling (e) Start-up and back-up fuel costs and (f) General administration and office costs.

6) The Company has used the fixed O&M component as approved by the Authority in its upfront tariff for 350 MW coal power plants after the completion of existing PPA (March 2028).

iii. **The following indexations shall be applicable to the Fixed O&M cost component:**

1) The Local Fixed O&M Cost Component shall be quarterly indexed to the WPI (manufacturing), as notified by the Pakistan Federal 8ureau of Statistics; and

2) The Foreign Fixed O&M Cost Component shall be quarterly indexed to both:

(i) the USD /PKR exchange rate, based on the revised TT & OD selling rate of USD notified by the National Bank of Pakistan; and

(ii) the US CPI, published by International Financial Statistics.

iv. **Return on Equity**

1) Return on Equity shall be as per the table provided in (a) above.

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2) The Return on Equity shall be quarterly indexed to the WPI (manufacturing), as notified by the Pakistan Federal Bureau of Statistics.

b) **Existing Capacity Payment**

i. The existing Capacity Payment will be applicable till the end of existing PPA (i.e. March 2028). Escalable Component of existing Capacity Payment will be taken till the end of existing PPA. Breakup of this component is not available as the 1994 tariff was based on upfront Bulk Power Tariff .The Escalable Component of existing Capacity Payment shall be Rs. 1.3129/kWh. The following table provides the summary of existing Capacity Payment calculation:

Escalable Component of existing Capacity Payment @ Ref & 60%	0.3590	Rs/kWh
Escalable Component of existing Capacity Payment @ Ref & 85%	0.2534	Rs/kWh
"IEt"	5.1811	
Escalable Component of Capacity Payment @ Present and 85%	**1.3129**	**Rs/kWh**
Calculation of "IEt"		
Present (2014)		
US$	97.10	
US CPI	120.00	
Reference (1994)		
US$	30.03	
US CPI	74.89	

ii. The following indexations shall be applicable to the existing Capacity Payment, which shall be indexed twice a year to both:

1) the USD /PKR exchange rate, based on the revised TT & OD selling rate of USD notified by the National Bank of Pakistan; and

2) the US CPI, published by International Financial Statistics.

c) **Non-Escalable Component**

i. The following table provides a summary of the Non-Escalable Component, which mainly comprises repayment of the principle portion of the debt and payment of interest thereon:

Years	Loan Payment Million USD	Interest Payment Million USD	Total Million USD	@ 100% CF Cents /kWh	@85% CF Cents/kWh
1	(17.16)	(10.39)	(27.55)	(0.9547)	(1.1232)

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2	(18.03)	(9.52)	(27.55)	0.9547)	(1.1232)
3	(18.93)	(8.62)	(27.55)	(0.9547)	(1.1232)
4	(19.89)	(7.66)	(27.55)	(0.9547)	(1.1232)
5	(20.89)	(6.66)	(27.55)	(0.9547)	(1.1232)
6	(21.95)	(5.60)	(27.55)	(0.9547)	(1.1232)
7	(23.05)	(4.50)	(27.55)	(0.9547)	(1.1232)
8	(24.21)	(3.34)	(27.55)	(0.9547)	(1.1232)
9	(25.44)	(2.11)	(27.55)	(0.9547)	(1.1232)
10	(26.72)	(0.83)	(27.55)	(0.9547)	(1.1232)
	(216.26)	**(59.23)**	**(275.50)**		

Debt repayment schedule is attached herewith as Annexure L.

ii. The following assumptions have been made in calculating this component:

1) Amount of Debt: USD (216.26) million (75% of total Project cost).

2) Term of debt: 30 months of grace period (construction) + 10 years of after the COD.

3) Interest Rates: 6 months LIBOR (0.45%) + Margin (4.50%).

4) Repayment: Quarterly mortgage style principal installments

5) 100% foreign debt is assumed in US Dollars. The Company may borrow from other bilateral, Export Credit Agencies (ECA) and or Development Financial Institutions (DFI), which could be in other currencies. In the case of partial local borrowing or inclusion of any other Foreign Currency (FCY), adjustments shall be made at actual at the time of the Financial Close.

6) The margin on foreign borrowing is assumed at 4.50%. In case the margin exceeds 4.50% due to adverse macro-economic conditions in Pakistan and/or liquidity constraints, adjustment shall be made at actual at the time of the Conversion Financial Close.

7) The Petitioner has assumed the terms including but not limited to the tenor of the debt based on international liquidity conditions. Any change in the actual debt terms would require readjustment of the debt component of the tariff.

8) The Coal Project drawdown schedule and related Interest during Construction (IDC) is based on preliminary assumptions. This will be adjusted at the Conversion COD on account of actual variation in

interest on the basis of actual drawdown for the period during construction.

9) No taxes or duties have been assumed on the repayment of the loans.

iii. The Non-Escalable Component shall be adjusted to:

1) The FCY/PKR exchange rate, based on the revised TT & OD selling rate of the respective FCY notified by the National Bank of Pakistan; and

2) The 6month LIBOR (or any other benchmark as applicable) rate at the end of each quarter.

iv. The foreign components of the Capacity Charge and the Energy Charge shall each be indexed periodically by using the FX Adjustment Factor according to the following formula:

$$\mathbf{FXadjust_{qy} = FXRate_{qy-1} / FXRate_{Ref}}$$

where:

$FXadjust_{qy}$	The FX Adjustment Factor applicable for the quarter
$FXRate_{qy-1}$	the quarterly TT & OD selling rate of US Dollar as notified by the National Bank of Pakistan which prevailed over the quarter prior to the quarter; and
$FXRate_{Ref}$	The Reference Exchange Rate (Rs. 97.1 per USD)

v. The foreign components of the Capacity Charge and Energy Charge shall each be indexed every quarter by using the Foreign Inflation Adjustment Factor calculated according to the following formula:

$$\mathbf{US\text{-}CPIadjust_{qy} = US\text{-}CPI_{qy-1} / US\text{-}CPI_{Ref}}$$

$US\text{-}CPIadjust_{qy}$	The Foreign Inflation Adjustment Factor applicable for the Quarter
$US\text{-}CPI_{yq-1}$	the United States Consumer Price Index notified by bureau of labor statistics (all urban consumers) for the prevailing Quarter; and
$US\text{-}CPI_{Ref}$	the Reference US-CPI (Ref: 120)

vi. The local components of the Capacity Charge and Energy Charge shall each be indexed every quarter by using the Local Inflation Adjustment Factor calculated according to the following formula:

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$$\mathbf{WPIadjust_{qy} = WPI_{qy-1} \ / \ WPI_{Ref}}$$

$WPIadjust_{qy}$	the Local Inflation Adjustment Factor applicable for the Quarter
WPI_{qy-1}	the wholesale price index (manufactures) notified by the federal bureau of statistics for the relevant Quarter; and
WPI_{Ref}	the Reference WPI (For July 2014) 216 Index Points

13.7 Pass-Through Items

In addition to the pass-through items stipulated in the standardized PPA and in the Petition herein, any taxes, duties and levies and or governmental impositions of whatsoever nature not factored in the tariff calculation shall be treated as part of the Project cost at the time of Conversion COD.

13.8 Adjustments at Conversion COD

a) At the Conversion COD, the Escalable and the Non-Escalable Components will be adjusted by the inflation factors and reference exchange rates, as the case may be, as defined and described herein.

b) The relevant reference tariff components shall also be adjusted on account of variation in US$/PKR, and by the then prevailing LIBOR and KIBOR (if applicable).

c) Debt service and ROE shall be adjusted on account of actual variation in debt and equity drawdown, actual interest during construction and financing costs/fees, actual customs duties and taxes. Once adjusted, the Debt service, ROE shall be updated according to the relevant indexations.

14 GENERAL ASSUMPTIONS

In addition to the assumptions made in the foregoing paragraphs, the following general assumptions have been taken into account while calculating the Petitioner's generation tariff. Changes in any of these assumptions will result in a change to the proposed tariff:

a) Assumed imported coal cost of $129.06/ton (as approved by NEPRA in upfront tariff).

b) HHV-LHV factor of 1.05 based on the average level of moisture.

c) Sales tax of 17% to be additional to the coal price.

d) Investment Cost of $ 288.35 million for Conversion, plus adders as mentioned above; to be funded with 25% equity and 75% local debt.

e) Customs/Import duties as per actual.

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f) Time period for implementation 36 months from financial close.

g) Net output to be maintained at 329.42 MW after the Conversion

h) Annual plant availability of 86.1% is assumed. Scheduled outage allowance of 30 days per unit per annum assumed, except in a major overhaul year where the scheduled outage period shall be 60 days per unit. Annual unscheduled outages of 500 hours per unit assumed. The Coal Project shall provide the electricity as a base load plant.

i) The Power Purchaser shall be responsible for procuring, financing, constructing, operating and maintenance of the interconnection, metering and transmission facilities at Additional Site.

j) Fuel consumed during commissioning / testing will be reimbursed by power purchaser as per actual.

k) The tariff is calculated on the basis of a notional 85% capacity factor.

l) A constant ROE is assumed, which results in an IRR of 24.50% over 25 years (as approved by NEPRA upfront tariff for new 350 MW power plants of imported coal).

m) Heat rate curves from the EPC Contractor to be used for partial load heat rate calculation and payment.

n) Annual degradation will be adjusted in Heat Rate based on the data provided by the EPC Contractor and OEM.

o) Minimum Load would be 40% of base load.

p) No hedging cost has been assumed for exchange rate fluctuations during construction.

q) No political risk insurance has been assumed on debt and/or equity. The premium prevailing at the time of financial close based on the changes in the international and Pakistani macro-economic situation including Pakistan's geopolitical situation would be charged.

r) No free startups are assumed.

s) The information pertaining to the plant net efficiency of 35.6 % (LHV).

t) The Coal Project EPC cost and Coal Project debts are assumed in US dollar. In case of any other foreign currency, indexation will be given in the applicable currency.

u) The tariff is based on minimum take or pay at 85% despatch level. Any liquidated damages levied by the coal suppliers due to lower despatch will be fully passed through to the Power Purchaser.

v) Additional coal (over and above the minimum take or pay) will be purchased through options and/or additional quantity from coal suppliers and/or spot market. Any additional cost and/or premia paid in this regard will be passed through to the Power Purchaser.

w) The Company has not assumed any security deposit that may be required by the coal suppliers pursuant to the CSA.

x) No royalty or any payment or fees to the relevant port authorities has been assumed.

y) All invoicing and payment terms are assumed to be in accordance with the standardized PPA specific to the coal power plants.

z) The Company has not assumed any costs that may be incurred for the Worker's Welfare Fund or Workers Profit Participatory Fund; any such costs shall be pass-through in terms of the PPA.

aa) Any benefit/concession/incentives given to any other IPP/project shall also be given to the Company.

bb) Any additional costs incurred to cater for any modifications or additions required by the Power Purchaser will form part of the Project cost at the COD.

cc) The petitioner assumed that power purchaser will pay the existing capacity payment during the down time for interconnection of new boiler with existing plant till the new COD.

dd) Delayed payment interest shall be adjusted at KIBOR + 2%

15 DETERMINATION SOUGHT

15.1 In light of the foregoing submissions, the learned Authority is kindly requested to approve the Company's Coal Tariff together with the pertinent indexations in accordance with the Coal Project costs and the assumptions related thereto mentioned above for a 25-years PPA term post Coal Project COD.

15.2 The Petitioner would be pleased to provide any further information, clarification or explanation that may be required by the Authority during its evaluation process. The Petitioner has attached herewith as Annexure M a copy of the pay order of fees.

Nishat Group

Lal Pir Power Limited
Through
Director Finance/Chief Financial Officer

Dated: 27 August 2014

Annexure J

Proposed Coal Conversion tariff table

Lalpir Power Limited

Year	Fuel Component	Ash Disposal	Lime Stone	Var. O & M Foreign	Var. O & M Local	variable component Foreign	variable component Local	Total EPP	Fixed O & M Local	Fixed O & M Foreign	Insurance	ROE	Debt Repayment	Interest charges	Total CPP	Cpacity charges 85%	Total Tariff Rs./kwh	Total Tariff cents/kwh	Curret Escalable Component of CPP at 85% capacity	Including existing cpp componet: Total Tariff Rs./kwh	Including existing cpp componet: Total Tariff cents/kwh
	Upfront Tariff for Imported Coal Based power plant								Foreign Financing												
	Energy Purchase Price (Rs./kw)								Capacity Purchase Price (PKR/KW/Hour)												
1	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.5774	0.3496	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
2	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.6065	0.3205	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
3	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.6371	0.2899	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
4	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.6692	0.2578	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
5	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.7030	0.2240	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
6	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.7384	0.1886	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
7	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.7757	0.1513	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
8	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.8148	0.1122	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
9	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.8559	0.0711	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
10	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.8990	0.0280	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
11	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
12	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
13	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
14	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
15	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
16	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
17	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
18	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
19	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
20	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
21	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
22	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
23	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
24	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
25	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	-	-	1.0190	1.1988	6.3654	6.5555	-	6.3654	6.5555
Average																					
1-10	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0221	0.0221	0.0617	0.5968	0.7277	0.1993	1.6297	1.9174	7.0839	7.2955	1.3129	8.3969	8.6477
11-25	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1535	0.1535	0.1152	0.5968	0.0000	0.0000	1.0190	1.1988	6.3654	6.5555	0.0000	6.3654	6.5555
1-25	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.1010	0.1010	0.0938	0.5968	0.2911	0.0797	1.2633	1.4862	6.6528	6.8515	0.5252	7.1780	7.3924
1-25	4.7012	0.2200	0.0900	0.0933	0.0622	0.1833	0.2822	5.1666	0.0646	0.0646	0.0790	0.5968	0.4740	0.1535	1.4324	1.6852	6.8518	7.0564	0.8888	7.7406	7.9718
	Levelized Tariff (including existing Capacity Payment) =							7.7406	Rs./kWh		7.9718	US Cents/kWh									

Annexure J

Lalpir Power Limited

Existing

Plant Factor 60%
Estimated Dependable capacity 337 MWH
UNITS AT 60 % Plant factor annual 1771.272 GWH

Days/Year 365
Hours /day 24

Agreement year	Energy Purchase price Rupees/Kwhr			Capacity Purchase Price Rupees/Kwhr			Total	Capacity Purchase Price Rupees/Kwhr/Month		
	Fuel Component	Variable O & M	Total	Escalable Component	Non-Escalable Component	Total	Rs./KWHr	Escalable Component	Non-Escalable Component	Total Capacity Purchase Price
1	0.653	0.03	0.683	0.359	0.935	1.294	1.9774	157,242	409,705	566,947
2	0.653	0.03	0.683	0.359	0.900	1.259	1.9420	157,242	394,200	551,442
3	0.653	0.03	0.683	0.359	0.900	1.259	1.9420	157,242	394,200	551,442
4	0.653	0.03	0.683	0.359	0.900	1.259	1.9420	157,242	394,200	551,442
5	0.653	0.03	0.683	0.359	0.900	1.259	1.9420	157,242	394,200	551,442
6	0.653	0.03	0.683	0.359	0.900	1.259	1.9420	157,242	394,200	551,442
7	0.653	0.03	0.683	0.359	0.815	1.174	1.8570	157,242	356,970	514,212
8	0.653	0.03	0.683	0.359	0.815	1.174	1.8570	157,242	356,970	514,212
9	0.653	0.03	0.683	0.359	0.767	1.126	1.8090	157,242	335,946	493,188
10	0.653	0.03	0.683	0.359	0.622	0.981	1.6640	157,242	272,436	429,678
11	0.653	0.03	0.683	0.359	0.624	0.983	1.6660	157,242	273,312	430,554
12	0.653	0.03	0.683	0.359	0.624	0.983	1.6660	157,242	273,312	430,554
13	0.653	0.03	0.683	0.359	0.624	0.983	1.6660	157,242	273,312	430,554
14	0.653	0.03	0.683	0.359	0.624	0.983	1.6660	157,242	273,312	430,554
15	0.653	0.03	0.683	0.359	0.624	0.983	1.6660	157,242	273,312	430,554
16	0.653	0.03	0.683	0.359	0.378	0.737	1.4200	157,242	165,564	322,806
17	0.653	0.03	0.683	0.359	0.040	0.399	1.0820	157,242	17,520	174,762
18	0.653	0.03	0.683	0.359	0.040	0.399	1.0820	157,242	17,520	174,762
19	0.653	0.03	0.683	0.359	0.040	0.399	1.0820	157,242	17,520	174,762
20	0.653	0.03	0.683	0.359	0.040	0.399	1.0820	157,242	17,520	174,762
21	0.653	0.03	0.683	0.359	0.009	0.368	1.0510	157,242	3,942	161,184
22	0.653	0.03	0.683	0.359	0.009	0.368	1.0510	157,242	3,942	161,184
23	0.653	0.03	0.683	0.359	0.009	0.368	1.0510	157,242	3,942	161,184
24	0.653	0.03	0.683	0.359	0.009	0.368	1.0510	157,242	3,942	161,184
25	0.653	0.03	0.683	0.359	0.009	0.368	1.0510	157,242	3,942	161,184
26	0.653	0.03	0.683	0.359	0.009	0.368	1.0510	157,242	3,942	161,184
27	0.653	0.03	0.683	0.359	0.009	0.368	1.0510	157,242	3,942	161,184
28	0.653	0.03	0.683	0.359	0.009	0.368	1.0510	157,242	3,942	161,184
29	0.653	0.03	0.683	0.359	0.009	0.368	1.0510	157,242	3,942	161,184
30	0.653	0.03	0.683	0.359	0.009	0.368	1.0510	157,242	3,942	161,184

Proposed

Agreement year	Energy Purchase price Rupees/Kwhr			Capacity Purchase Price Rupees/Kwhr			Total	Capacity Purchase Price Rupees/Kwhr/Month		
	Fuel Component	Variable O & M	Total	Escalable Component	Non-Escalable Component	Total	Rs./KWHr	Escalable Component	Non-Escalable Component	Total Capacity Purchase Price
1	4.7012	0.4654	5.1666	2.1397	1.0906	3.230	8.3969	1,327.69	676.71	2,004.40
2	4.7012	0.4654	5.1666	2.1397	1.0906	3.230	8.3969	1,327.69	676.71	2,004.40
3	4.7012	0.4654	5.1666	2.1397	1.0906	3.230	8.3969	1,327.69	676.71	2,004.40
4	4.7012	0.4654	5.1666	2.1397	1.0906	3.230	8.3969	1,327.69	676.71	2,004.40
5	4.7012	0.4654	5.1666	2.1397	1.0906	3.230	8.3969	1,327.69	676.71	2,004.40
6	4.7012	0.4654	5.1666	2.1397	1.0906	3.230	8.3969	1,327.69	676.71	2,004.40
7	4.7012	0.4654	5.1666	2.1397	1.0906	3.230	8.3969	1,327.69	676.71	2,004.40
8	4.7012	0.4654	5.1666	2.1397	1.0906	3.230	8.3969	1,327.69	676.71	2,004.40
9	4.7012	0.4654	5.1666	2.1397	1.0906	3.230	8.3969	1,327.69	676.71	2,004.40
10	4.7012	0.4654	5.1666	2.1397	1.0906	3.230	8.3969	1,327.69	676.71	2,004.40
11	4.7012	0.4654	5.1666	1.1988		1.199	6.3654	743.85	-	743.85
12	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85	-	743.85
13	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85	-	743.85
14	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85		743.85
15	4.7012	0.4654	5.1666	1.1988		1.199	6.3654	743.85		743.85
16	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85		743.85
17	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85	-	743.85
18	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85	-	743.85
19	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85		743.85
20	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85	-	743.85
21	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85	-	743.85
22	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85	-	743.85
23	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85		743.85
24	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85	-	743.85
25	4.7012	0.4654	5.1666	1.1988	-	1.199	6.3654	743.85	-	743.85
	-	-	-	-	-	-	-	-	-	
	-	-	-		-	-	-	-	-	
	-	-	-		-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	

Annexure K

Lalpir Power Limited

Interest during Construction (IDC) Calculation

Debt Amount	Million USD	196.50
LIBOR		0.45%
Spread		4.50%
Total Interest Rate		4.95%

		Construction Period			Debt Principal	IDC	Fin. Fee
Year		1st Year	2nd Year	3rd Year			
Opening Balance		0	80.57	165.20			
1st Quarter		10%	10%	10.00%			
Pincipal Amount addition		19.65	19.65	19.65	58.95		13.76
Financing Fee(% of Total Loan)	7.00%	13.76	-	-			
Interest		0.12	1.12	2.17		3.41	
Closing Balance		19.77	101.34	187.01			
Opening Balance		19.77	101.34	187.01			
2nd Quarter		10%	10%	10.00%			
Pincipal Amount addition		19.65	19.65	19.65	58.95		
Interest		0.37	1.38	2.44		4.18	
Closing Balance		39.79	122.36	209.10			
Opening Balance		39.79	122.36				
3rd Quarter		10%	10%				
Pincipal Amount addition		19.65	19.65		39.30		
Interest		0.61	1.64			2.25	
Closing Balance		60.05	143.65				
Opening Balance		60.05	143.65				
4th Quarter		10%	10%				
Pincipal Amount addition		19.65	19.65		39.30		
Interest		0.86	1.90			2.76	
Closing Balance		80.57	165.20				
Total Debt including IDC					196.5	12.60	13.76

Annexure L

Lalpir Power Limited

Upfront Tariff - Debt analysis/Repayment profile (imported coal)

Gross Capacity	362 MWH	USD/PKR Parity	97.1			
Net Capacity	329.42					
Libor	0.45%	Equity	25%	6,999.76	PKR Million	
Spread over & above Kibor	4.50%	Debt	75%	216.26	Million USD	
Total Interest rate	4.95%	Debt in Pak rs.		20,999.27	PKR Million	
Annual Output	2885.7192 000' MWH					

Debt Repayment Service Amount		
Annual Installments	qtrly	4
Debt Tenor	years	10
Total Installments	qtrly	40
		216.26
	i %	4.95%
	quarterly rate	0.012375
	(1+i)^40	1.635522334
	((1+i)^40) - 1	0.635522334
(i/4*(1+i)^4)/(((1+i)^4) - 1)		0.031847172
Debt Service Amount		6.89

Period		Principal	Principal Repayment	Interest	Balance	Debt Service	Principal Repayment	Interest	Debt Servicing
		Million USD				$ Million	Rs./KW/H		
	1	216.26	4.21	2.68	212.05	6.89			
	2	212.05	4.26	2.62	207.79	6.89			
	3	207.79	4.32	2.57	203.47	6.89			
	4	203.47	4.37	2.52	199.10	6.89	0.5774	0.3496	0.9270
1st Year			17.16	10.39		27.55			
	1	199.10	4.42	2.46	194.68	6.89			
	2	194.68	4.48	2.41	190.20	6.89			
	3	190.20	4.53	2.35	185.67	6.89			
	4	185.67	4.59	2.30	181.08	6.89	0.6065	0.3205	0.9270
2nd Year			18.03	9.52		27.55			
	1	181.08	4.65	2.24	176.43	6.89			
	2	176.43	4.70	2.18	171.73	6.89			
	3	171.73	4.76	2.13	166.97	6.89			
	4	166.97	4.82	2.07	162.15	6.89	0.6371	0.2899	0.9270
3rd Year			18.93	8.62		27.55			
	1	162.15	4.88	2.01	157.26	6.89			
	2	157.26	4.94	1.95	152.32	6.89			
	3	152.32	5.00	1.89	147.32	6.89			
	4	147.32	5.06	1.82	142.26	6.89	0.6692	0.2578	0.9270
4th Year			19.89	7.66		27.55			
	1	142.26	5.13	1.76	137.13	6.89			
	2	137.13	5.19	1.70	131.94	6.89			
	3	131.94	5.25	1.63	126.68	6.89			
	4	126.68	5.32	1.57	121.36	6.89	0.7030	0.2240	0.9270
5th Year			20.89	6.66		27.55			
	1	121.36	5.39	1.50	115.98	6.89			
	2	115.98	5.45	1.44	110.53	6.89			
	3	110.53	5.52	1.37	105.01	6.89			
	4	105.01	5.59	1.30	99.42	6.89	0.7384	0.1886	0.9270
6th Year			21.95	5.60		27.55			
	1	99.42	5.66	1.23	93.76	6.89			
	2	93.76	5.73	1.16	88.04	6.89			
	3	88.04	5.80	1.09	82.24	6.89			
	4	82.24	5.87	1.02	76.37	6.89	0.7757	0.1513	0.9270
7th Year			23.05	4.50		27.55			
	1	76.37	5.94	0.95	70.43	6.89			
	2	70.43	6.02	0.87	64.41	6.89			
	3	64.41	6.09	0.80	58.32	6.89			
	4	58.32	6.17	0.72	52.15	6.89	0.8148	0.1122	0.9270
8th Year			24.21	3.34		27.55			
	1	52.15	6.24	0.65	45.91	6.89			
	2	45.91	6.32	0.57	39.59	6.89			
	3	39.59	6.40	0.49	33.19	6.89			
	4	33.19	6.48	0.41	26.72	6.89	0.8559	0.0711	0.9270
9th Year			25.44	2.11		27.55			
	1	26.72	6.56	0.33	20.16	6.89			
	2	20.16	6.64	0.25	13.52	6.89			
	3	13.52	6.72	0.17	6.80	6.89			
	4	6.80	6.80	0.08	(0.00)	6.89	0.8990	0.0280	0.9270
10th Year			26.72	[illegible]		27.55			

LIST OF ANNEXURES

- Affidavit: as per requirement of Rule 3(8) of Tariff Rules.
- Board Resolution regarding Authorization to sign and file.
- Detailed breakup of EPC cost of the project of USD 248 million.
- Specifications make and model of the new boiler.
- Justification for selecting, subcritical technology against the super critical.
- Salvage value of the existing boiler and Auxiliaries intended to be replaced by an accredited agency.
- New boiler efficiency and the efficiency of the existing steam turbine.
- Details of existing land holding.
- Details of new land and land development cost of USD 4 million.
- Detailed breakup of the estimated development and construction management cost of USD 10 million.
- Calculation of financing charges of USD 13.76 million.
- Calculation of return on equity component of tariff.
- Details of existing updated capacity purchase price.
- Justification of applying the existing variable O&M cost of RFO complex to converted coal complex.
- Calculation of the fixed O&M of the coal power complex.
- Detailed Comparison of existing updated and proposed tariff showing the increase/decrease in energy and capacity charges and net saving per unit of electricity generated.
- Estimated saving over the life of the project and payback period.
- Copies of EPC proposals from EPC contractors.
- Technical evaluation of Bids

444425

Rupees 50 ۵۰ روپیہ

AFFIDAVIT

I, Khalid Qadeer Qureshi, Director of LalPir Power Limited, 1-B, Aziz Avenue, Canal Bank, Gulberg V, Lahore, holding CNIC No. 35202-8191856-7, do hereby solemnly affirm and declare that the contents of the accompanying Tariff Petition (including all supporting documents) with regard to any statement of facts or opinion are true to the best of my knowledge and information therein is true to the best of my belief.

Deponent

Verification

Verified on oath this 18th day of August 2014 that the contents of the above affidavit are true and correct to the best of my knowledge and belief and nothing has been concealed therefrom.

Deponent

۱۹/۹/۱۱

کد ۲۶

[illegible] گزارش دو صفحه‌ای گزارش [illegible]

[illegible]

LALPIR POWER LIMITED

NISHAT

CERTIFIED COPY OF THE RESOLUTIONS PASSED BY THE BOARD OF DIRECTORS OF LALPIR POWER LIMITED IN THEIR MEETING HELD ON July 23, 2014, AT 2:30 P.M., AT 1-B, AZIZ AVENUE CANAL BANK, GULBERG V, LAHORE.

RESOLVED that the Tarrif Petition be filed with National Electronic Power Authority (NEPRA) for Approval to convert the existing Power Plant of the Company into Coal Firing subject to regulatory approval.

RESOLVED that any of Mian Hassan Mansha, having CNIC No. 35202-1479111-5 and/or Mr. Shahid Zulfiqar Khan, having CNIC No. 35202-2262470-9, and/or Khalid Qadeer Qureshi, having CNIC No. 35202-8191856-7 (hereinafter referred as "the authorized persons) of **Lalpir Power Limited** (hereinafter referred as "the Company") be and are hereby empowered/authorized ***Singly*** to institute and file Petition for tariff determination with National Electric Power Regulatory Authority ("NEPRA") in respect of Coal Conversion of existing 362 M W Power Plant of the Company and are also authorized to:-

- Institute, file, sign and verify petition(s), applications, replies and all other Legal documents and to swear affidavits and to make statements:
- engage and instruct counsel and or to delegate all or any of his powers hereby granted, in favour of counsel and to authorize counsel to exercise such powers and to make statements as deemed appropriate before NEPRA and/or any authority;
- Take all or any action/deeds/things necessary for the aforesaid on behalf of the company;
- The same shall be construed to have been filed or given on the behalf of the Company.

FIRTHER RESOLVED that Mr. Faisal Islam of Faisal & Partners, Advocates & Legal Advisors, Sarwar Road, Lahore be and is herby appointed as Consultant to prepare, submit and follow up Tariff Petition and all other document/Papers etc as are necessary and required by NEPRA or any other Authority in connection with Coal Conversion Tariff Petition.

ALSO RESOLVED that a certified true copy of these Resolutions duly signed by the Chief Executive or any of the Directors or Company Secretary be issued to whom it may concern and they may also affix the common seal of the Company, if so required and shall remain enforced until notice in writing to the contrary duly signed is issued.

Certified True Copy issued on 23rd day of July 2014.

KHALID MAHMOOD CHOHAN
COMPANY SECRETARY

LALPIR POWER LIMITED

ANNEXURE '3"

BREAK UP OF EPC COST

Description	HARBIN
Boilers and direct auxiliaries (primary & secondary air fans, ID Fans, coal silo, mills, PC distribution circuit, HSD distribution circuit, burners, bottom ash extraction, sampling and chemical dosing, piping rack):	US$ 135 MM
Coal unloading, storage and handling /ash handling and storage:	US$ 58 MM
Electricity and I&C:	US$ 25 MM
Flue gas treatment to reach environmental requirements:	US$ 25 MM
Contingency :	US$ 5 MM
Total:	**US$ 248 MM**

Further details at Section 11.3 of the main Petition:

ANNEXURE "4"

Boiler Technical Specifications by HARBIN China:

Description	units	HARBIN (HEI)
Superheated steam outlet flow	t/h	1185
Superheated steam outlet pressure	Kg/cm^2g	178.4
Superheated steam outlet temperature	°C	541
Feed water temperature	°C	283.3
Reheat steam outlet flow	t/h	978
Reheat steam inlet pressure	Kg/cm^2g	41.3
Reheat steam outlet pressure	Kg/cm^2g	38.3
Reheat steam outlet temperature	°C	541
Reheat steam inlet temperature	°C	337.8
Boiler Efficiency	%	89%

- Further details at section 9.3.

ANNEXURE'5'

JUSTIFICATION OF SUB CRITICAL TECHNOLOGY

Existing RFO based boiler is hooked up with a Steam Turbine having following major parameters;

Steam Turbine inlet Temp.: 541 °C

Steam Turbine inlet Pressure: 169 kg/cm2

The above technology parameters can only be complimented with the sub critical coal boiler rather than a super critical boiler. This is worth mentioning that under our proposed arrangement, only boiler and its associated ancillaries will be replaced for conversion to coal firing project, whereas, steam turbine & generator would not be replaced. Super critical technology can only be used if complete revamping of the existing plant including turbine/generator and its auxiliaries is done which is not an economical solution. This would practically be constructing a new plant at the existing site. Hence, to keep the project viable as compared to new coal projects, only oil fired boiler will be replaced with coal fired sub critical boiler.

Further details at Section 8.3 of the Main Petition:

PROFILE OF SALVAGE VALUE/
EVALUATION CONSULTANTS FOR BOILEER

INTRODUCTION

INTRODUCTION

M/s Unit-3 Consultants, is an organization committed to provide Professional Consultancy Services since 1980, in the following fields:

1. Surveys (on site or social) and providing **Project Valuation** (for all types of properties / assets, including Land, Building, Machinery plants, Infrastructure, Stocks and Assets etc.)
2. Preparation of Feasibility Reports.
3. Planning, Designing and Engineering (Civil, Electrical Mechanical, Public Health and Environment etc) works, all types of projects relating to Housing, Commercial, Industrial, Institutional.
4. Interior Design, Renovation, Remodeling and Decoration.
5. Preparation of Working, Construction Drawings and Detail etc.
6. Preparation of Specifications, BOQ's Cost Estimates Tender Documents etc.
7. Construction Management of Projects or on " TURNKEY" Basis
   and now entering into
8. **Muccadum, Search Reports and Title Verification Services**, also.

Our team of professionals consists of qualified and experienced Architects, Engineers (Civil Electrical, Mechanical, public Health and Environmental etc) and Interior Designers, with a wide range of experience in their respective fields. The firm has got at its disposal all the supporting staff, office, computer section and other necessary infrastructure and facilities to execute the above-mentioned types of projects. We have got with us trained and experienced staff and associates i.e. Architects, Engineers, Surveyors / Inspectors.

We know that the surveying / evaluation of projects is a highly sensitive and specialized job and requires professional and systematic approach to organize and manage the assignment, which we definitely claim to adopt, while doing our Projects. Our 20 years history with Banks witnesses our claim.

For TURNKEY Projects Renovation, Remodeling and Interior of offices, bank buildings, we have available with us designers, skilled workers and interior specialists. The team is fully aware of the latest materials and their best use to save cost, time, ensuring quality and smooth completion of the work.

We have already been working for many organizations on their Housing Projects, i.e. " VALANCIA" , " IZMIR", "LDA" "LCCHS" and "LMC", " Cantt. Board" etc. we have planed, designed, constructed, renovated, remodeled offices / bank buildings on Turn Key Basis also.

SURVEYS & VALUATION SERVICES

Approved Evaluators by "Pakistan Banks Association (PBA)" for all the banks through out Pakistan on its panel – I, II & III (all types of projects i.e. Land, Building, Machinery, Assets, etc.)

Approved Evaluators by "Leasing Association of Pakistan (LAP)" for all the leasing companies through out Pakistan (all types of projects i.e. Land, Building, Machinery, Assets, etc.)

Approved Valuers by Corporate & Industrial Re-structuring Co-operatinn (CIRC)

(Valuating its referred properties in all areas of Pakistan.)

We have so far prepared thousands of regular valuation reports referred by almost all the banks of values ranging from Rs. 0.5 Million to Rs. 300 Million plus, including land, building, Plant, machinery, fitting / fixture, stores and stocks.

The big projects include, Ittefaq Textiles, Cresent knitwear, Textillion (Pvt.) Ltd. Maroof Dying, Sulman Chemicals, UBC Convertec Pvt. (printing) Ltd, Haral Textiles Mills, Cold Storages, Rice and Oil factories etc. confirming that, we are a fully competent and well experienced to evaluate any type of property / project and at any level and scale.

We have successfully completed well in time EVALUATION PROJECT of 13000 of houses, awarded by House Building Finance Corporation of Pakistan in the districts of Punjab, NWFP & AJK: -

i. Lahore
ii. Sheikhupura
iii. Jehlum
iv. Rawalpindi
v. Attok
vi. Murree
vii. Rawalakot
viii. Abbotabad
ix. Mansehra
x. Bahawalpur

Such a huge number of housing properties were difficult to trace out even but our staff got it done within scheduled time which was, of course, remarkable achievement of the company.

MUCCADUM, SEARCH REPORTS & TITLE VERIFICATION SERVICES:

We have established an independent cell under the supervision of qualified and experience ex-banker to provide high quality Muccadum, Search Report and Title Verification Services to our valued clients / banks. Knowing the seriousness of the above said job- lawyers, accountants, supervisors & muccadums, etc. have also been engaged / employed to provide the best possible services.

Principal Office:
65/172-CMA Colony, St-3 Lahore Cantt.
Ph:6673062, 6660344 Tel/Fax:6669849 E-mail: panjnad_pk@yahoo.com

OUR VALUATION METHODOLOGY:

All the information about the property surveyed including its location / approaches, land, building, machinery, infra structure etc. along with property documents and Photo graphs (from different angles and in case of machinery from inside working or Static Positions), invoices, receipts and local cost / rates etc, are send by these trained persons to our Head office in Lahore. All the above documents, information, rates etc, are checked by our Head Office persons and any discrepancy Pin pointed is rectified.

The final valuation report is prepared after confirmation of rates of land, building and especially that of machinery (through our data already Collected and confirmation its prices from the local market or people dealing in the Sale / Purchase, repairs and maintenance of this type of machinery. This way all our valuation reports are prepared after a comprehensive verification of all the above information about the property.

We have introduced **a Centralized System of Preparation of these Reports** only to ensure a standardized and systematic document preparation and to avoid Possible local interference in our branch offices. This way, we try to ensure the quality of our reports and avoid much discrepancy. However if there are still some human error or discrepancy and even after submitting our reports, we remain in constant touch with the bank to rectify it any time.

STOCK VERIFICATION:

We have engaged the experience persons from the locality to get their skilled opinion on the stock being pledged, hypothecated or evaluated. This practice is adopted by beyond our responsibility to provide additional information to our Clients / Banks.

Principal Office:
65/172-CMA Colony, St-3 Lahore Cantt.
Ph:6673062, 6660344 Tel/Fax:6669849 E-mail: panjnad_pk@yahoo.com

AFFIDAVIT

It is certified and confirmed that we have never been involved in any litigation with any Govt. organization, nor we have been black listed by any private organizations.

For M/s UNIT – 3 Consultants

M. Afzal Malik
(Principal Executive)

LAHORE CITY / HEAD OFFICE

Address: 65 / 172, Street – 3, C.M.A Colony, Lahore Cantt.
Ph. 042 – 6673062, 6660344,
Mobile: 0300 – 4202108, 0300 – 4946187, 0333 – 4267725,
Fax: 092 – 042 – 6669849

S. No	Employees Name & Designation	Qualification	Experience
1.	M. Afzal Malik (C.E.O)	National Diploma in Arch. (NCA) 5-Years After FSc	25-years experience as a Member PCATP & IAP.
2.	M. Ishaq Waheed Butt (Senior Manager)	Graduate & Post Graduate Diploma in Business Admin.	30-Years in Banking services
3.	Wasif Ali (Civil Engineer)	B. Sc. (Civil Engg.), M.Sc (Environmental Engg.) (UET Lahore)	1 ½-years
4.	Hameed Asghar (Senior Architect)	B. Architecture (UET)	4-years
5.	Muhammad Akram (Mech. Engineer)	B.Sc. Mech. Eng.	10-years
6.	Abdullah Sajjad (Senior Surveyor)	B. Architecture (UET)	1-years
7.	Abdul Hameed (Senior Surveyor)	Asstt. Engineer D.A.E (Civil)	25-years
8.	Saqib Majeed (Senior Surveyor)	Asstt. Engineer D.A.E (Civil)	2-years
9.	Samer Ishaq Butt (Manager Muccadum Services)	Graduate in Commerce, Diploma in Business Administration (PU)	5 – Years in Management of Muccadum / Valuation Services
10.	Tallat Shahzad (Accountant)	B. Com.	5 – Years as Manager Accounts.
11.	Aneela Naseem (Admn. Manager)	M.A (Economics), DCS	2 – Year
12.	Ch. Umar (Assistant Officer)	Graduate & DCS	3 – Years
13.	Muhammad Ali (Surveyor)	D. A. E (Electronics)	15 – Years
14.	Muhammad Sohail (Surveyor)	D. A. E (Electronics)	2 – Years
15.	Muhammad Aslam (Senior ITO)	I. C. S.	7 – Years in IT
16.	Rana Zubair	M.S.C (Mathematics)	5 – Years
17.	Waqas Mahmood	F.A & (Civil Draftsman)	2 – Years
18.	Nasir Mahmood	(Civil Draftsman)	1 – Years
19.	Khalid Nawaz Ghumman (Legal Advisor)	M.A.L.L.B.	5-years as an Advocate

BRANCHES / CONTACT AREAS

AREA OFFICES / CONTACT PERSONS

HEAD OFFICE LAHORE:
65/172, Street - 3, CMA Colony, Lahore Cantt.
Ph: 042 - 6673062, 6660344, Fax: 6669849,
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Ph: 061-6772059,
Mobile: 0300 - 6110713,

SAHIWAL, OKARA:
MUZAFFAR IQBAL
New Pakistani Commission Shop
Shop No.104, Gallah Mandi, Okara.
Mobile. 0322 - 5651270,

GUJRANWALA:
ATIF SIDDIQUE CH.
Office No. 7, Lepari Hotel, G.T Road,
Gujranwala.
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Mobil: 0300 - 4917534,
Email: atif.trust@gmail.com

ABBOTTABAD:
RANA ZUBAIR
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Flat No. 201, Opposite Chinar CNG,
Main Mansehra Road, Abbottabad.
Ph: 0992-385252, Mobil: 0346- 9534061,

RAWALPINDI / ISLAMABAD:
TAYYAB AMJAD
First Floor Al-Bilal Plaza,
Chandani Chowk, Rawalpindi.
Ph: 051-4851035, Mobil: 0333 - 5111302,

SIALKOT:	**MUHAMMAD ASHFAQ** 61 /1 Tariq Road Sialkot Cantt. Mobil: 0300 – 6122355,
KARACHI:	**RANA TARIQ MUKHTAR** 132 - Muslim Colony Adj 'F.T.C' Shahrah - e – Faisal, Karachi. Mobile: 0300 – 3349772, 0333 – 3022233 Ph: 021 – 4395457, Fax: 021 – 4395457,
RAHIM YAR KHAN:	**IFTIKHAR MUGHAL** 16 – Model Town, Rahim Yar Khan. Mobile: 0300 – 8677553
PESHAWAR:	**M. DILDAR – UL – HUSSAN** Abdullah Plaza, Opp Peshawar Model College For Girls, Dalazaq Road, Peshawar. Ph: 091-2584057, Mobile: 0300 – 5858345
FAISALABAD:	**NAVEED AHMAD** New Hamza Center, First Floor, College Road, Madina Town, Faisalabad Ph: 041-8002778, Mobile: 0321-9666972
AZAD JAMMU KASHMIR:	**RAJA AMIR ASLAM KHAN** Graphics & Stationers, Girls College Road, Muzaffarabad Azad Kashmir. Mobile: 0300-5075018

Unit – 3 Consultants

Organization Structure

Principal Executive

Senior Manager

Manager Accounts / Recovery

Area Managers

HO Area Lahore

Karachi	Rahim Yar Khan
Bahawalpur	Multan
Okara	Faisalabad
Gujranwala	Sialkot
Rawalpindi	Peshawar
Abottabad	Muzafarabad (AJK)

PAKISTAN BANKS' ASSOCIATION

Reference : PBA-PV-0076-BC

Date : April 8, 2010

Mr.Muhammad Afzal Malik
Unit-3 Consultants
65/172-C M A Colony, Street # 3, Cantt,
Lahore

Dear Sir

Enlistment on PBA's List of Approved Valuers - 2010

Pakistan Banks' Association hereby confirms your enlistment for the year 2010 on the following panels of its List of Approved Valuers:

Panel One - (For Valuation of Land and Buildings)
Panel Two - (For Valuation of Plant and Machinery)
Panel Three - (For Valuation of Current Assets and Commodities)

We recommend your Valuations to be accepted by Banks and Financial Institutions against credit facilities of Rs.1200 million or less.

You shall abide by PBA's Code of Conduct and Regulations concerning Professional Valuers at all times.

This enlistment is valid till December 31, 2010, and is granted in accordance with, and subject to the terms and conditions of the 2009 update of the Guidelines for Enlistment & Monitoring of Professional Valuers.

Thank you.

Yours truly

Masood H. Raza
Secretary

D-126, Block 4, Clifton, Karachi 75600
Telephones : 021-582-2986-7, Fax : 021-582-3418, Email :pba@pakbankers.com

Dawood Islamic
BANK LTD
(Formerly First Dawood Islamic Bank Ltd.)

June 12, 2008

Mr. Muhammad Afzal Malik
65/172-C M A Colony,
Street # 3, Cantt,
Lahore.

Dear Sir,

We are pleased to inform you that your company has been approved by our management and it has been enlisted in the panel list of Dawood Islamic Bank Limited and its customers.

Enclose please find herewith the draft copy of Service Level Agreement (SLA) enabling you to provide the related services for Dawood Islamic Bank.

You are requested to kindly send us the duly filled in and signed copy (2 copies) of this SLA on Rs.100/- legal paper each

Your early response in this connection will be appreciated. For enabling us to advise our branches, for taking your services accordingly.

If you need any further assistance please do not hesitate to contact the undersigned

Thanks and best regards

Abdul Wahab Agar
Officer
Centralized Operations
2637174 ext 2503

Mirza Faizan Ali
Assistant Manager
Centralized Operations
2637174 ext 2510

The Bank of Khyber

BoK/HO/CAD/2009/ 1781

February 9, 2009

Muhammad Afzal Malik
Principal Executive
Unit-3 Consultants
65/172-C M A Colony, Street # 3, Cantt,
Lahore

Dear Sir,

ENLISTMENT OF YOUR FIRM ON BOK'S PANEL OF EVALUATORS

We are pleased to inform that your firm has been short listed on our bank's panel of approved evaluators. You may approach any of our branches for providing valuation services.

For complete list and location of our Bank's branches please visit our web site: www.bok.com.pk

Regards,

Abdus Saboor Khan
ABDUS SABOOR KHAN
Incharge Monitoring Department

ZAHOOR AHMAD KHAN
VP/Head CAD

HEAD OFFICE: 24 - The Mall, Peshawar Cantt, 25000, N.W.F.P. Islamic Republic of Pakistan.
UAN: +92-91-111 95 95 95 Website: www.bok.com.pk

Arif Habib Bank

Ref: AHBL/CD/11/10

February 15, 2010

To,
Mr. Ishaq Waheed Butt
Unit -3 Consultants
65 / 172 - CMA Colony,
Street-3, Lahore, Cantt

<u>SUBJECT: ENLISTMENT ON APPROVED PANEL OF VALUERS</u>

Dear Sir,

With reference to your letter Ref. UT-AHB-217 dated 17 October, 2009, we are pleased to advise you that we have enlisted your firm on the approved panel of valuers of our bank.

Regards,

Faiza Paracha
Senior Officer
Credit Division

Nabeel Elahi
Vice President
Credit Division

No. 23, Arif Habib Centre, M. T. Khan Road, Karachi - Pakistan. Tel: 021-32437892, 32436519, 32472804 UAN: 111-124-725 Fax: 021-32435736
E-mail: info@arifhabibbank.com Website: www.arifhabibbank.com

NATIONAL BANK OF PAKISTAN

Credit Management Group
Credit Management & Co-ord. Wing

HO/CMG/CMCW/07/
September 11, 2007

All Regional Credit Management Chiefs

Dear Sirs,

ENLISTMENT OF PROFESSIONAL VALUERS –
M/S. UNIT-3 CONSULTANTS

We may advise that M/s. Unit-3 Consultants has been approved by the PBA as Professional Valuers and was circulated for information, vide our circular letter No.HO/CMG/P&PW/(VALUERS)/06/1882 dated 13.11.2006.

Yours faithfully,

Sd/-
(Muhammad Riaz Khokhar)
Executive Vice President

C.c. to:

M/s. Unit-3 Consultants, 65/172-CMA Colony, Street-3, Cantt. Lahore for information.

Executive Vice President

Head Office: I.I. Chundrigar Road, Karachi. Ph. (021) 9212714 – Fax (021) 9212278

FAYSAL BANK LIMITED فیصل بینک لمیٹڈ

July 10, 2008

M/s Unit-3 Consultants
ATTN: Mr. Rana Sajjad
Office No.2, 1st Floor,
63-C, 13th Commercial Street
Phase-II Extension, DHA,
Karachi

SUB: **Enlistment on Approved Panel of Inspection Agencies**

You are already on approved panel of Valuators of Faysal Bank Ltd.

We are pleased to inform you that you now have been also included in the panel of Inspection Agencies of Faysal Bank Limited on pan-Pakistan basis. Enclosed please find the asset inspection agreement between your firm and FBL in this regard. Please arrange to return the same to us duly signed and company stamped for our record purposes.

We may contact you as and when your services are required for inspection matters on case-to-case basis and on professional fee to be mutually agreed.

Thanks & regards,

M. Arif A. Karim
Head- Credit Administration

Iqbal Ahmed Zuberi
Country Operations Head

Allied Bank

Bath Island, Karachi - 75600
UAN: 111-110-110 e-mail: abl.cok@abl.com.pk

By Courier

Risk Management Group
Credit Administration Division

Muhammad Afzal Malik
Principal Executive
Unit-3 Consultant
65/172-C MA Colony
Street # 3,
Cantt.
Lahore.

AR/MYZ/CAD/2007/49
May 9, 2007

Dear Sir,

Re: Enlistment on ABL's Approved Panel Of Stock Inspecting Firms

We are pleased to inform you that your company has been enlisted on ABL's approved panel of Stock Inspecting Firms.

Please note that professional charges for providing stock inspection services have to be pre-agreed between you and the concerned Manager, Regional Credit Administration Department (RCAD) in writing before taking any assignment.

You may now start providing Stock Inspecting Services to the Bank on terms and conditions to be advised by our Regional Credit Administration Departments (RCADs)

In case of any query, please feel free to contact the undersigned at 111-110-110 Ext.2231/2233 or 021-5370182.

Yours truly,

Ahmad Rasheed
Assistant Vice President

M. Yahya Zafar
Credit Administration Officer

February 7, 2008

M/s. Unit-3 Consultant
65/172-CMA Colony
St-3 Lahore Cantt.

Subject: Enlistment as Surveyor.

This refers to your letter Ref.No: UT-KASB-74 dated April 19, 2007.

We are pleased to inform you that we have included your Company's name in the approved panel of our Bank's Surveyors.

We hope that the assessment to be made by you will be without conceiving any influence, inconformity of the prices prevailing in the market, due care will be exercised in protecting interest of the Bank and charges for the valuation / assessment will be competitive / reasonable.

Yours truly,

Akamdar

Ashraf Kamdar
Head of CAD-H.O.

BANK ALFALAH LIMITED بينك الفلاح المحدود

CMU/JM/417/08
December 06, 2008

Credit Monitoring Unit

M/s. Unit 3 Consultants
65/172-CMA Colony
St-3 Lahore Cantt.
Lahore.
Telephone(s) : 042-6660344, 042-6673062
Fax : 042-6669849

Col ieo &
all offices
12/12

Dear Sir,

RENEWAL OF ENLISTMENT ON BANK'S APPROVED PANEL OF VALUATORS / SURVEYORS

This refers to exchange of correspondence with you on the above subject. We are pleased to inform that the Bank management has acceded to your request of renewal of enlistment on our Bank's panel. You will be required to, invariably, provide following information in your valuation report with regard to the surveyed assets / property.

1. The valuation would clearly describe the nature of property/assets such as residential or commercial / industrial.
2. The basis of evaluation i.e. cost, present market value and forced sale value etc.
3. Elaborate or comment on the building structure and quality of construction of the properties surveyed.
4. Highlight any negative feature relating to property surveyed, which may prove detrimental to the interest of the Bank either in the short or long term. This would include not only structural aspects but also matters concerning ownership, planning approvals, alternate use, restrictions, proximity to hazardous factors etc.
5. The valuation report should also contain comment on any tenancy or leasehold effect on the value of assessed property and its sale ability etc.

Your enlistment is subject to following conditions:

a) You will always work in the interest of the Bank and render true professional services as and when required. Your fee would always be most competitive and reasonable enough to be acceptable to the Bank / Clients.
b) If the Bank is dis-satisfied with your performance, conduct, technical efficiency, the Bank will be at liberty to suspend or remove your firm from the approved list without assigning any reason thereof.
c) Assignment of evaluation tasks will be at Bank's discretion
d) This enlistment will be effective upon your acceptance of the terms and condition on the copy of this letter, which you will return to us duly, signed dated and stamped.
e) Further renewal of your enlistment is subject to satisfactory valuation services provided to our branches and on periodical performance evaluation carried out by the bank.

Regards,

ABDUL RAUF DANKA
Senior Manager

MAHMOOD ASHRAF
General Manager

Accepted:__________________ / Date

LEASING ASSOCIATION OF PAKISTAN

LAP/191/38
25 January 2008

Mr. Afzal Malik
Principal Executive,
Unit-3 Consultants,
LAHORE CANTT.

Panel of Professional Valuers

Dear Sir,

We acknowledge receipt the renewal fee for the financial year 2008 (receipt enclosed) and hereby confirm the enlistment of your company on the registered and approved Panel of Professional Valuers of Leasing Association of Pakistan.

Latest list of our member companies is enclosed for your information and further action at your end.

This enlistment is valid till **December 31, 2008**.

Thanking you.

Yours faithfully,
For Leasing Association of Pakistan,

(RAZIA IMAM)
PA to Secretary General

602, 6TH FLOOR, PROGRESSIVE CENTRE, 30-A, BLOCK 6, PECHS, SHAHRAH-E-FAISAL, KARACHI-75400, PAKISTAN
TEL. 021-4389774-5 FAX: 021-4389775 E-MAIL: lap@super.net.pk WEBSITE: www.pakistanleasing.org

The Bank Of Punjab

(ESTABLISHED UNDER THE BANK OF PUNJAB ACT, 1989)
CREDIT, TRAINING & SPECIAL PROJECTS DIVISION

HO/CTSP/2004/519/03/2372 JANUARY 28, 2004.

M/s. Unit-3 Consultants,
65/172, Street #3,
CMA Colony,
Lahore Cantt.

Dear Sir,

ENLISTMENT OF MUCADDAMS ON BANK'S APPROVED PANEL

This is with reference to your request letter for enlistment of Mucaddam.

We are pleased to inform that your name has been included in the list of Bank's approved Mucaddam with immediate effect.

Please contact the respective branch(es)/Regional Office(s) to complete formalities and confirm compliance of the instructions.

We look forward to mutually beneficial relationship.

With regards,

TARIQ JAVED BUTT
Vice President

PRIME

BANK

Mr. M. Afzal Malik
Chief Executive
Unit-3 Consultants
65/172-CMA Colony
St-3, Lahore Cantt

November 3, 2004

Dear Sir,

RE: **ENLISTMENT AS "MUCCADAM"**

This refers to your letter No.UT/PBL/V-5847 dated October 29, 2004 regarding above.

We are pleased to inform you that the name of your firm has been enlisted on our Bank's approved Panel of Muccadams. Through a copy of this letter, we are informing our Branches of your enlistment. You will be contacted by the branches, in case a service is required by them.

Please note that all charges are on account of the customers.

Yours faithfully,

Akhtar Masih
Vice President

cc:to: The Chief Managers, Prime Commercial Bank Ltd. all Branches.

MR.11.2004

Prime Commercial Bank Ltd.
Head Office:
77-Y, Phase III, Commercial Area,
L.C.C.H.S., Lahore-Cantt.
Tel: (042) 572-8282 Fax: (042) 572-8181

May 2, 2005

Mr. Afzal Malik
Unit-3 Consultants
5, 172-CMA Colony
I-2 Lahore Cantt

<u>Enlistment as Surveyor</u>

Dear Sir

We take pleasure in advising you that your request to be enlisted on our approved panel of surveyors, has been approved. Our Branches, on all Pakistan basis, are being advised accordingly.

You shall be at liberty to provide evaluation services to us only upon our commissioning such an evaluation, for panel 1,2 and 3. It is to further clarify that you shall be entitled to receive your professional fee, as negotiated on a case-to-case basis. We shall expect a high level of professional competence and integrity from your company.

We look forward to establishing an enduring and mutually beneficial relationship with you.

Yours sincerely,

Naveed I. Sherwani
Senior Vice President
Risk Management Group

Union Bank Limited
New Jubilee Insurance House, I.I. Chundrigar Road, Karachi (Pakistan). UAN: (021) 111 001 002 Fax: 2400842 - 2415371
Telex: 21081 UNB PK

October 16, 2004

Mr. M. Akram
Unit-3 Consultants
65/172-CMA Colony,
St-3 Lahore Cantt.

Dear Sir

We are pleased to inform you that your company has been enlisted as Muccadam on our bank's approved panel.

We expect that all assignments given to your company, in this capacity, will be handled independently and with professional competence.

For Muccadamage agreement to be duly executed between yourself and the Bank, you are requested to get in touch with our Ms Rubina Roohi, Credit Administration Head, Lahore office. It is to further clarify that you shall be entitled to receive your professional fee on a case-to-case basis.

We look forward to establishing an enduring and mutually beneficial relationship with you.

Yours sincerely,

Naveed I. Sherwani
Senior Vice President
Risk Management Group

HABIB BANK LTD

Tel #92-21-2412245 / Fax # 92-21-2412255

ENGG & MAINT DIVISION
05-HB Plaza, Head Office,
Karachi

FR/ENL/2002/188
October 25, 2001

M/S. UNIT – 3 CNSULTANTS
172-CMA Colony, ST-3,
Lahore Cant.

Dear Sir,

ENLISTMENT AS SURVEYORS & PROPERTY EVALUATORS

Please refer to application of enlistment of your firm with our Bank, we are pleased to inform you that after scrutiny of Bio-Data, your firm has been enlisted far the works and categories as under:

1) Nature of work — **SURVEYORS & PROPERTY EVALUATORS**

2) Category — ________

3) Limit of work to be awarded based on Engineer's Estimate — ________

The enlistment of your firm is subject ta the following conditions:-

1) That you will take active part in campeting tenders invited from time to time. Failure to do so may result in removal of your firm from approved penal of contractors:

2) If the bank is dissatisfied with the quality of your work, canduct or technical efficiency, Engg. & Maintenance Division shall be at liberty ta suspend or remove your name from approved panel af contractors.

Date extended for next year

This enlistment will hold good up to **31' December, 2002** in case yau desire to get your name renewed after expiry of this period, you may apply in writing far renewal at the appropriate time, failing which your name shall automatically be struck off from the appraved list. The bank reserves the right to withhold or cancel renewal ar de-list yau without assigning any reason thereof.

Receipt of this letter may kindly be acknowledged.
Thanks,

Yaurs foithfully,

M. FAZLURREHMAN
VP & DY. CHIEF ENGINEER

ASKARI COMMERCIAL BANK LTD.
The Security Bank - A Name to Trust

Head Office, The Mal
RAWALPINDI - 4600

SYSTEMS & OPERATIONS DIVISION

SOD/17.2/961 /2001
May 9, 2001

Mr. Afzal Malik
Architect
UNIT-3 Consultants
172-CMA Colony, St.3,
Lahore Cantt.

Dear Sir,

APPROVED VALUERS - PAKISTAN BANKS ASSOCIATION

Please refer to your letter No.UT-ACB-01 dated 5.5.2001 requesting for enlistment of your company on our bank's panel of professional Valuers.

Please note that we have already circulated the lists of Professional Valuers approved by PBA, wherein you are enlisted. You may, therefore, contact our branches for providing your valuable services. As regards your charges, please note that the branches will negotiate the charges on case to case basis.

Thanking you,

Yours truly,

MUHAMMAD SAGHIR
Vice President

Full Address: AWT Plaza, The Mall, P.O. Box 1084, Rawalpindi - 46000, Pakistan.
Tel: PABX: (051) 5518117-20, UAN: 111-000-787, Fax: 5563704, SWIFT: ASCMPKKA, Tlx: 54647 ASKRI PK.

The Bank Of Punjab

(ESTABLISHED UNDER THE BANK OF PUNJAB ACT, 1989)
OPERATIONS DIVISION

[illegible]/2001 308 January 11, 2001

M/s. [illegible] Construction,
[illegible] Colony,
Lahore Cantt.

Dear Sir,

PLACEMENT ON THE PANEL OF APPROVED VALUES R
DESIGN/RENOVATION/REMODELING SERVICES

This refers to your letter No.07/600-02 dated 4th January, 2001 on the captioned subject.

This is to inform you that your firm has been pre qualified and enlisted in our Bank's approved contractors' list for construction, repair & renovation works.

Please note that you have been pre-qualified on the basis of your own provided information. If anything find in contrary to these information, your pre-qualification will be treated as cancelled.

Yours faithfully,

Ijaz

(MUHAMMAD IJAZ AZIZ)
ASSISTANT VICE PRESIDENT

Head Office : 7 - Egerton Road, Lahore, Pakistan. P.O. Box 2254 - Postal Code No,. 54000
PBX 6372304 to 6372312 Grams : "Ravibank" Fax : 6370464, 6310591, 6369549, 6310283

ALLIED BANK
OF PAKISTAN LTD.

ABL

الائیڈ بینک
آف پاکستان لمیٹڈ

ESTD. 1942

CO/MAINT/NA/2001/ 147

01 [illegible] 2001

M/s. Unit – 3 Construction,
Architects, Engineers & Interior Designer,
172 – CMA Colony,
Lahore Cantt.,

Att. Mr. Afzal Malik

Dear Sir,

RE: ***ENLISTMENT OF 'UNIT – 3 CONSTRUCTION' IN ABL APPROVED LIST OF PANEL***

This refers to your letter No. UT-ABL-01 dated 20.12.2000, on the subject cited above. In this context, please be informed that no previous request as such has been received in this office, as indicative from the "Reminder" in your aforecited letter.

Your request however, is now being directed to the concerned office of the Regional General Manager, Lahore for necessary action in the matter.

Yours faithfully,

(S. M. I. RIZWE)
Vice President & Chief,
Maint., Engg. & Sty., Divn.,
Central Office, Karachi.

c.c. to: The Regional General Manager, ABL, Regional Office, Lahore with the request to appraise the request on merit and further necessary action.

General Manager

HBFC

ہاؤس بلڈنگ فنانس کارپوریشن

REF: HBFC/ZOL/CS/2001/

Date: 11.04.2001

TO WHOM IT MAY CONCERN

It is certified that M/S.Unit 3 Construction 172 C.M.A colony, Lahore Cantt has been appointed as valuers to carry out the valuation of properties assigned to HBFC. The work of the said professional valuers has been found satisfactory.

(ZAHID ALI KHAN)
MANAGER(C.S)

1-LAKE ROAD, LAHORE. TEL : 7236920 FAX : 7236973

General Manager

HBFC

ہاؤس بلڈنگ فنانس کارپوریشن

REF: HBFC/ZOL/36/2001/

Date: 11.04.2001

<u>TO WHOM IT MAY CONCERN</u>

It is certified that M/S.Unit 5 Construction 172 C.M.A colony, Lahore Cantt has been appointed as valuers to carry out the valuation of properties assigned to HBFC. The work of the said professional valuers has been found satisfactory.

(ZAHID ALI KHAN)
MANAGER(C.S)

CBR 163 UNDER THE INCOME TAX ORDINANCE, 2001 (FOR INDIVIDUAL / AOP)

CNIC	35201-1360920-1	NTN	1319370
Name	MUHAMMAD AFZAL MALIK	Tax Year	2007
Business Name	M/S UNIT - 3	RTO/LTU	

Final Tax Statement u/s 115(4)

	Source	Code	Receipts/Value	%	Code	Tax Due
51	Imports	64011		6	65011	-
52		64012		1	65012	-
53		64013		2	65013	-
54		64014		3	65014	-
55	Dividend	64031		5	65031	-
56		64032		10	65032	-
57		64033		7.50	65033	-
58	Profit on Debt	64041		10	65041	-
59	Royalties / Fees	640511		15	650511	-
60		640512			650512	-
61	Contracts (Non-Resident)	640521		6	650521	-
62	Supply of Goods	640611		3.50	650611	-
63		640612		1.50	650612	-
64		640613			650613	-
65	Services	640621	673,950	6	650621	40,437
66	Contracts (Resident)	640631		6	650631	-
67		640632			650632	-
68	Exports/Indenting Commission/ Exp. Services	64071		0.75	65071	-
69		64072		1	65072	-
70		64073		1.25	65073	-
71		64074		1.50	65074	-
72	Foreign Indenting Commission	64075		5	65075	-
73	Property Income subject to WHT	64081		5	65081	-
74	Prizes	64091		5	65091	-
75	Winnings	64092		10	65092	-
76	Petroleum Commission	64101		20	65101	-
77	Brokerage/Commission	64121		10	65121	-
78	Advertising Commission	64122		10	65122	-
79	Stock Exchange Commission	64131		5	65131	-
80	Goods Transport Vehicles	64141		0.01	65141	-
81	Retail Turnover upto 5 million	310102			920102	-
82	Retail Turnover above 5 million	310103		0.50	920103	-
83	Total (51 to 82)		673,950		6595	40,437

Fixed Tax

	Source	Code	Receipts/Value	Rate	Code	Tax Due
84	Property Income not subject to WHT	210101		5	920235	-
85	Purchase of locally produced edible oil	310401		1	920203	-
86	Flying Allowance	112001		2.50	920234	-
87	Employment Termination Benefits	118301			920211	-
88	Total (84 to 87)				920211	-
89	Total Tax Due (83 + 88)		-		9202	-
90	Tax Paid/Deducted					40,437
91	Tax Payable/ Refundable to be transferred to Net Tax Payable (to 44)		Evidence Attached ✓		94591	40,437

Verification

I, MUHAMMAD AFZAL MALIK

holder of CNIC No. 35201-1360920-1, in my capacity as Self / Partner or Member of Association of Persons/Representative (as defined in section 172 of the Income Tax Ordinance, 2001) of Taxpayer named above, do solemnly declare that to the best of my knowledge and belief the information given in this Return/Statement u/s 115(4) and the attached Annex(es), Statement(s), Document(s) or Detail(s) being correct and complete in accordance with the provisions of the Income Tax Ordinance, 2001 and Income Tax Rules, 2002. (The alternative in the verification, which is not applicable, should be struck out.)

Date (dd/mm/yyyy) 20-09-2007 Signature M.A. Malik

Acknowledgement

CENTRAL BOARD OF REVENUE MEDIUM TAX PAYERS UNIT

2 8 SEP 2007

Signature & Stamp of Receiving Officer with Date

Note: 1. Grey blank fields are for official use

GOVERNMENT OF PAKISTAN
REVENUE DIVISION
CENTRAL BOARD OF REVENUE

NATIONAL TAX NUMBER CERTIFICATE

(Issued under section 20 of the Finance Act, 1999)

National Tax Number (NTN) 1319370 - 8

Name: MUHAMMAD AFZAL MALIK

Address: UNIT 3 CONSULTANTS
65-172 CMA COLONY STREET NO.3,
LAHORE.
PHONE NO. 6660344

Status/Nature: BUSINESS INDIVIDUALS

NIC/Firm Reg./Company Inc.Number. /New NIC: 35201-1360920-1

This certificate shall be prominently displayed at a conspicuous place of the premises in which business or work for gain is carried on. It is also required to be indicated on the signboard wherever it is affixed.

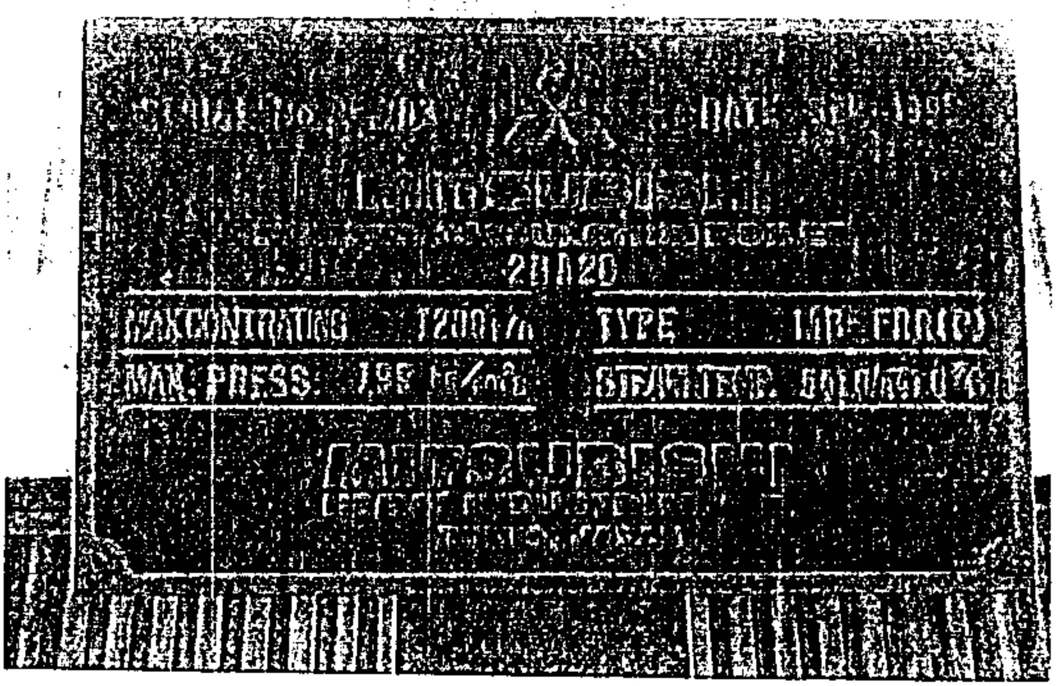
Date of Issue 08/02/2005

Chairman

PROPERTY/ASSETS EVALUATION REPORT

For

LALPIR POWER LTD



Property at: Lalpir Power Ltd. Lalpir district Muzafargarh

AUG: HO. Nishat - W6 - 01

VALUATION CONSULTANTS
(PBA's Approved Valuers in All Banks Panels
(Highest Category for all over Pakistan)

UNIT-3
CONSULTANTS
Architects, Engineers, Surveyors & Valuation Consultants
Muccadam, Search Reports & Title Verification Services

Property Evaluation Report

AUG: HO. Nishat - W6 - 01

1	Date Survey Conducted	18-08-2014
2	Name of Account	Lalpir Power Ltd.
3	Present owner of the property	Lalpir Power Ltd
4	Property Address	Lalpir Power Ltd, Lalpir district Muzaffargarh

A. DESCRIPTION OF THE PROPERTY/ASSETS:

1	Type of property	[illegible] Boiler (MB FRR), Boiler
2	Age of Property	17 years
3	Expected life	20 years

AUG: HO. Nishat - W6 - 01

UNIT-3 Consultants
2-12

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Specifications:

- Steam Flow
  - [illegible] outlet (at BMCR) — [illegible],200,000 kg/hr
  - Reheat Outlet (at BMCR) — [illegible]
- Steam Pressure
  - Superheater design — [illegible] kg/cm² g
  - Superheater outlet (at BMCR) — 176 kg/cm² g
  - Reheat design — [illegible]
  - Reheat outlet (at BMCR) — [illegible] kg/cm² g
- Steam Temperature
  - Superheater outlet — [illegible] °C
  - Reheater outlet — [illegible] °C
  - Reheater inlet (at BMCR) — [illegible] °C
- Steam Temperature control range:
  - Superheater — [illegible] to 100% MCR
  - Reheater — 60% to 100% MCR
- Feed water temperature
  - Economizer inlet (at BMCR) — [illegible]

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Special Features:

I Boiler maximum continuous rating (B-MCR)

The boiler is capable of producing steam [illegible] at steam condition of [illegible]

[illegible] g 541 / 541 °C as B-MCR

II Operating Conditions

Minimum Load Operation

The Power Station is designed to operate continuously under automatic control at 20 [illegible] of ECR

Salability components after Disassembling:

Sr No.	Assets/Parts	Demand	
1	Turbines	00	existed
2	Super Heaters	Not known	existed
3	Reheaters	do	00
4	Economizer	do	00
5	Steam drums	80%	existed
6	Tubes	60%	existed
7	Furnace materials	50%	existed
8	Diesel Oil Transfer Pumps (45kW)	85%	existed
9	Auxiliary Boiler Diesel Oil Pumps (2.2 kW)	85%	existed
10	Igniter Oil Transfer Pumps (3.7 kW)	85%	existed
11	HFO Transfer Pump2 (74.6 kW)	85%	existed
12	Forced Draft Fans (3,000 kW)	85%	existed

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13	Gas Recirculation Fans (610 kW)	85%	existed
14	Boiler Circulation Pumps (360 kW)	85%	existed
15	AC Cooling Fan (11 kW)	85%	existed
16	DC Cooling Fan (11 kW)	85%	existed
17	Igniter Fan (11 kW)	85%	existed
18	Steam Air Heater Drain Pumps (3.7 kW)	85%	existed
19	Fuel Homogenizers (22 kW) with VFDs	85%	existed
20	Homogenizers Booster Pumps (30 kW)	85%	existed
21	Variable Voltage Variable Frequency (VVVF) Drives for FDFs	85%	existed
22	Variable Voltage Variable Frequency (VVVF) Drives for GRFs	85%	existed
23	Steam Air Heater	85%	existed
24	Gas Air Heater	85%	existed
25	Steam Converter	50%	existed
26	Different Valves, Pipe, Ducts, Instruments, Cables, Steel sheets, Molds and all Metallic frames etc	50%	existed

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- ASSESSMENT OF THE PRPERTY

Asset Name	Mits Basic Forced Circulation Radiant Reheat Boiler
Used age of Assets	17 years
Expected Remaining Life	20 years

- Value of Complete Unit
  - Commercial Market Value — No demand in Pakistan and Abroad!
- Salvage/Scrap/ Wreckage Value (Purely Estimated) — Rs. 119, 000,000/-

(This report is purely prepared on human estimation though based on existing factors but any consulting body can apply its mind to reach the value of such assets which have no relevance in the environment)
Not for use of courts or arbitrations)

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UNIT-3 Consultants Architects & E...

Malik

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CONSULTANTS REMARKS: -

ASSETS & LOCATION:

- Our team of surveyors and inspectors visited the site named Lalpir Thermal Power Unit Located at Lalpir Power Ltd. Lalpir district Muzafargarh operating there since last 17 years and providing electricity to the National Grid of Pakistan.
- We were asked to inspect the Mitsubishi Forced Circulation Radiant Reheat Boiler (MB-FRR) as the same is being replaced with another unit to be fueled with Coal Fire Heating System
- The boiler consisting of Pumps, Combustion Air Blowers, Flue Economizer, Steam Traps, Piping. Is found in working order
- In our observation this boiler, a specific purposed boiler, has no demand in the market due to multiple reasons of budgeting / profitability of the product to be gained by its use.
- This boiler, according our information, is the only one of its type in Pakistan. No other Industry is in use of such a huge boiler of remote technology of tube system.
- As such its disposal in the compact position in Pakistan is rare chance which may arise sometimes in future otherwise in the present circumstances it carries a zero chance
- Yet we have noted that many of its parts are of salable capacity in different type of industries and a buyer can come up to purchase it but he will be confronted to firstly dismantle it and its removal on

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Urgency basis from this premises along with space requirement for secure keeping and disassemble it before approaching to proper market for sale it's by parts individually all these processes will cost him high influencing purchase price negatively and lowering the offer.

- Keeping all the factors, positive/negative our deduction of estimated value/cost we have to place at the point that although the boiler is fully fit to perform for next 20/25 years with higher fuel price but its purchase demand in the market is exist no where showing its sale/demand at Zeroed indicate that it can only be sold as wreckage.
- Leaving all the negative factors aside after all the boiler and its parts are made of mostly by steel and copper metals which have clear and non finishing demand in the market as such we derived its scrap value adopting a conservative method of weight of metals used and present in the unit.
- In the process as there is no precedent with us or in our the market of the country regarding the weight of boiler capable of producing 1200 ton/hour steam pressure ,we have to construct it weight on the basis of small boiler unto the capacity of producing 140 ton/hour of steam pressure.
- As such determination of Salvage, as required by the client in the letter of charter to basis based on following process

i. Estimation of weight of boiler as a unit in tons/1000kg.

ii. Estimation of scrape value of mettles of the boiler in the scrape market.

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iii. Estimated ratio of mettles used in the boiler and its presence
In boiler its parts

iv. Estimation of costs of Expected buyer deciding to purchase the unit

v. Estimation of Dismantling cost of the unit

vi. Estimation of storage of boiler and its security.

vii. Estimation of costs of disassembling of the boiler into
Moveable/saleable and quantifiable parts

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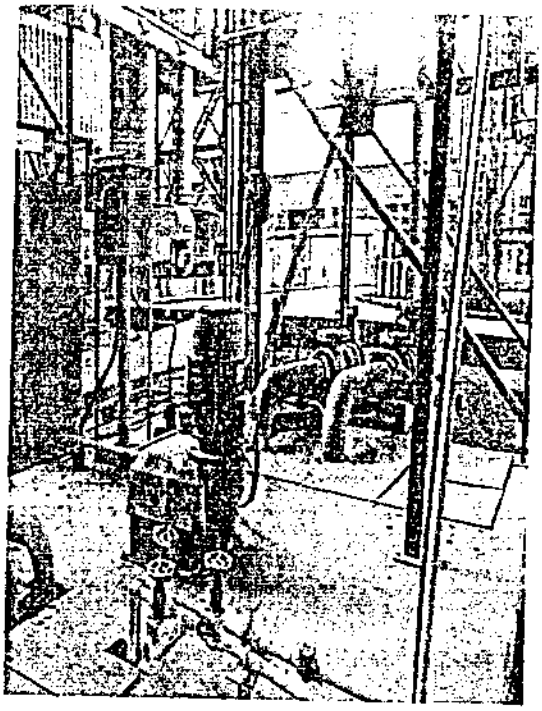

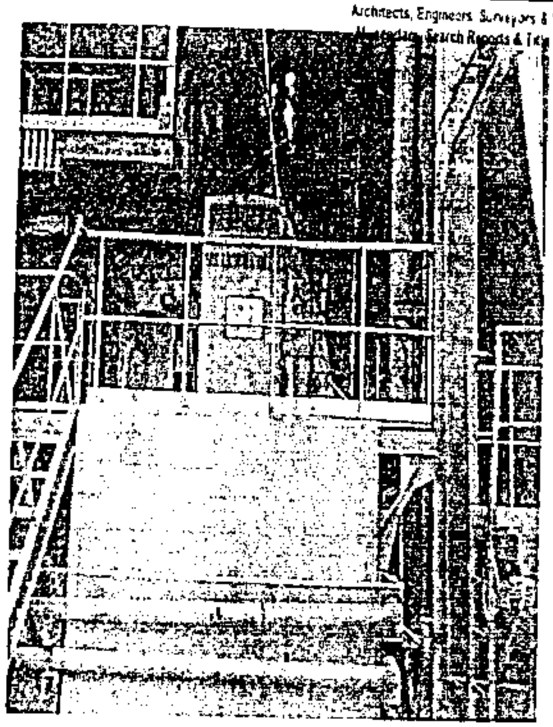

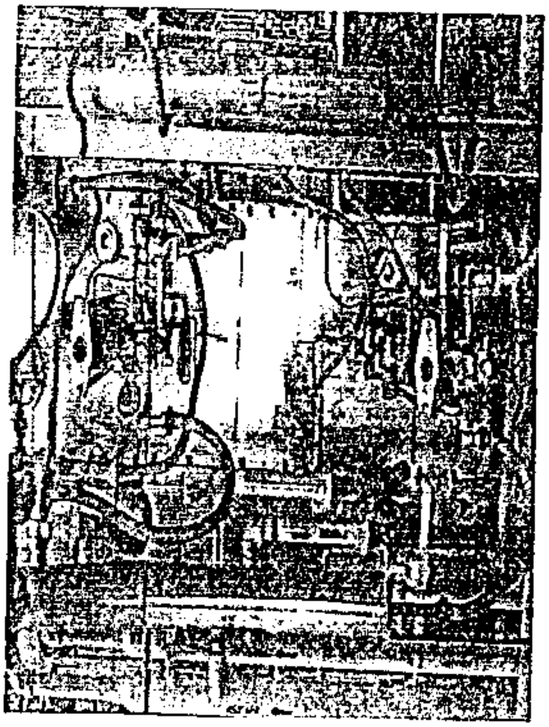

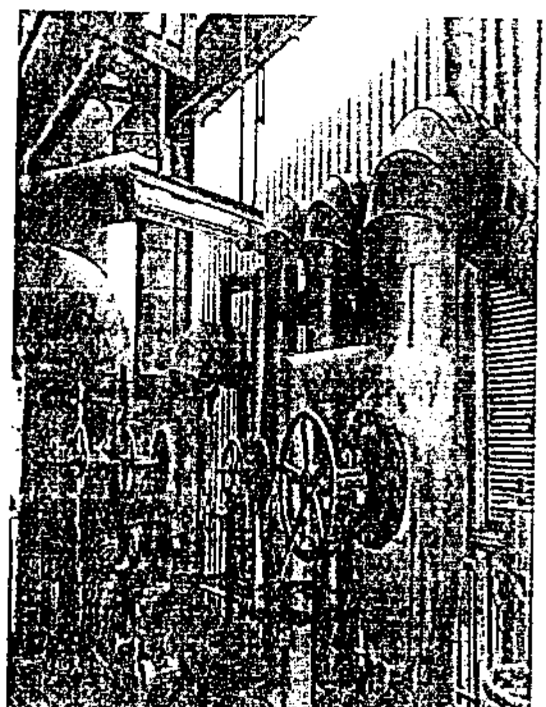

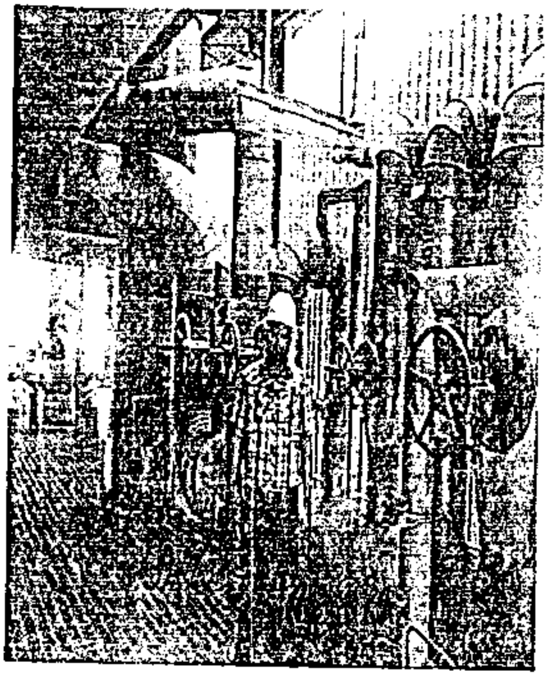

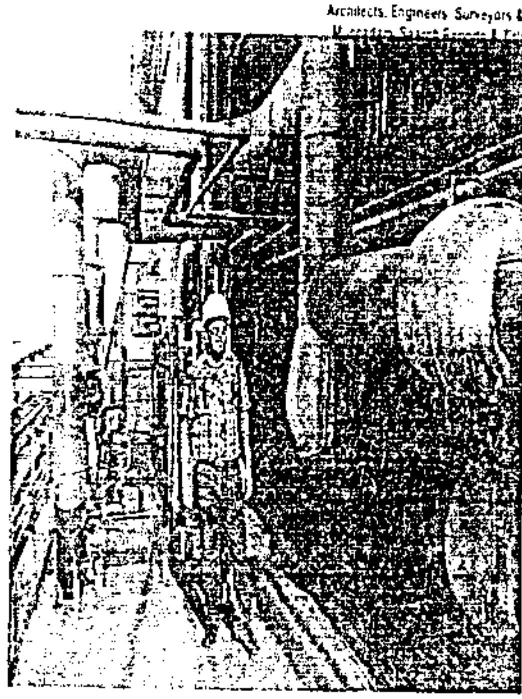

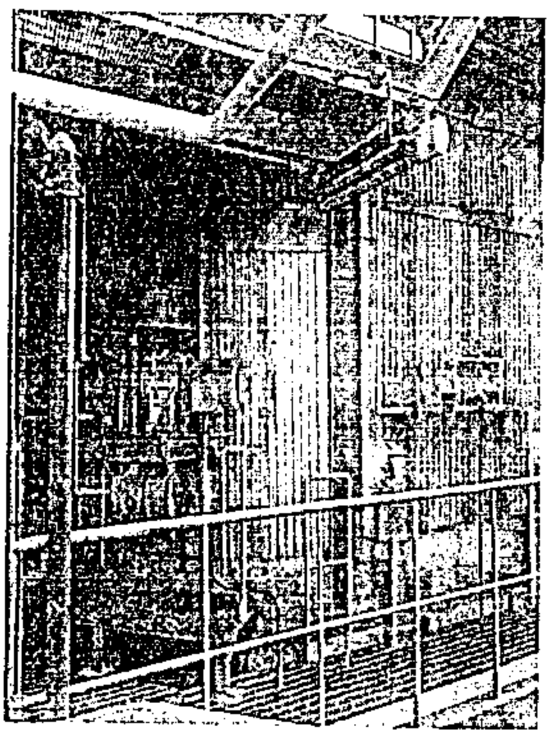

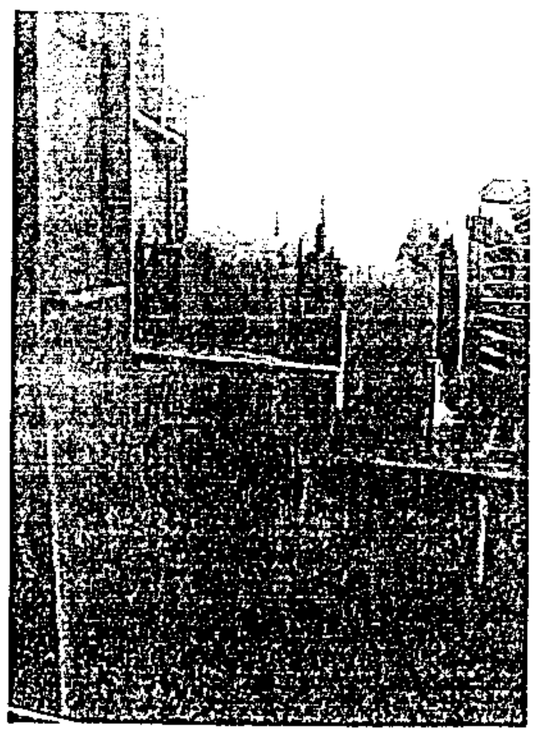

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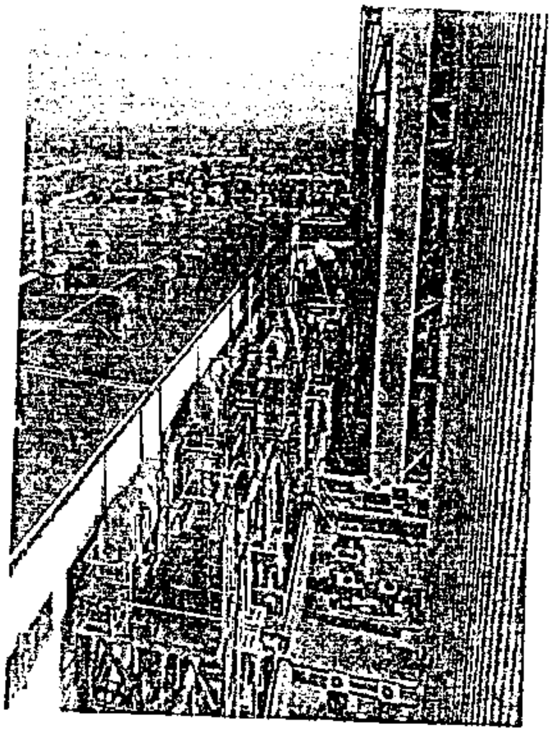

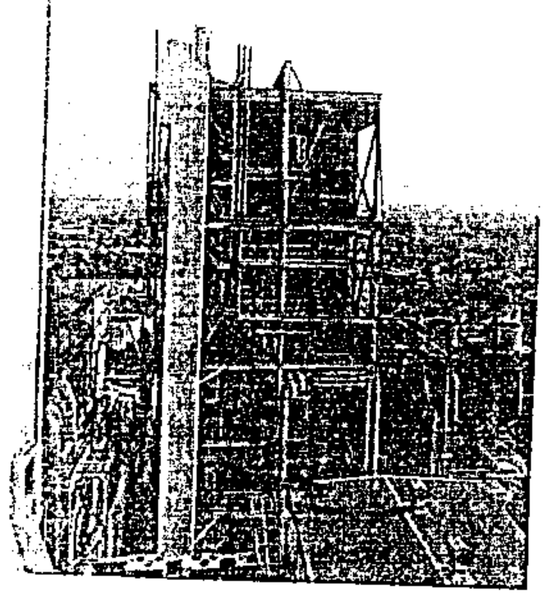

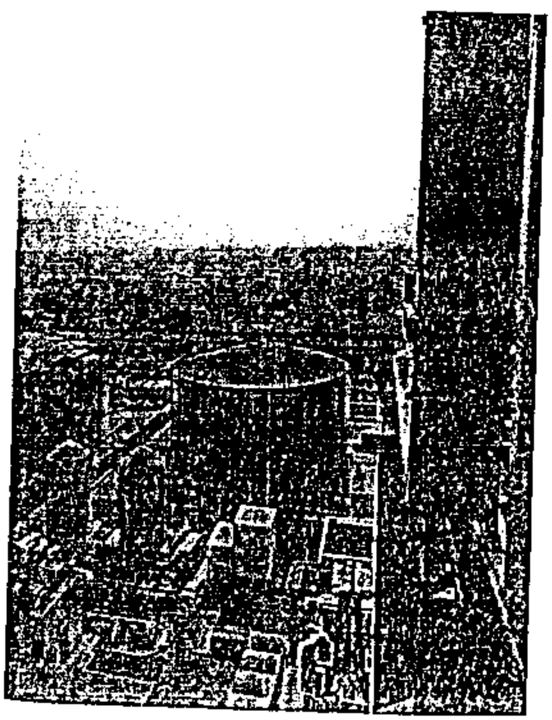

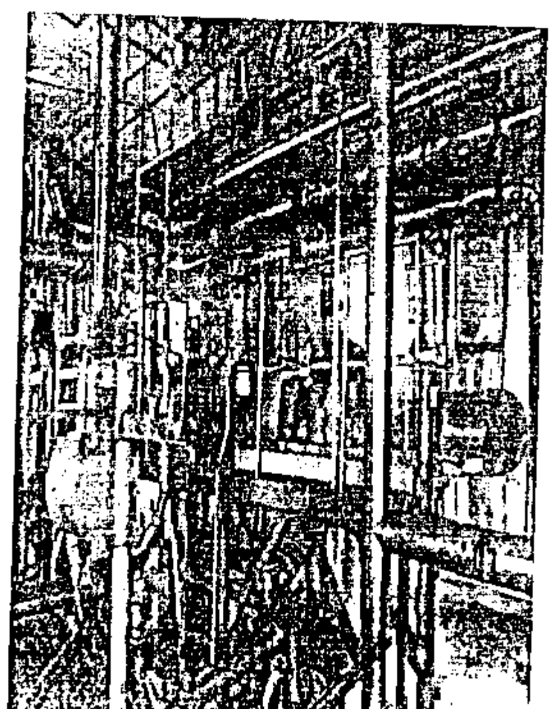

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ANNEXURE '7"

NEW BOILER AND TURBINE EFFICIENCY

Specification, Make & Model of new Boiler and Existing Turbine Efficiency:

Make	Harbin China
Capacity	1,185 t/h
Pressure at super heater outlet	17.5 MPa
Pressure at re heater inlet	4.052 MPa
Pressure at re heater outlet	3.856 MPa
Temperature at super heater outlet	541 oC
Temperature at re heater inlet	337.8 oC
Temperature at re heater outlet	541 oC
Feed Water Temperature	283.3 oC
Flue gas temperature after ESP	131.65 oC
Boiler Efficiency	89%
Existing Turbine Efficiency:	43.94%

ANNEXURE' 8"

Land Record as per Intiqals

Updated in Jun 2014	Existing Land	
LalPir	K	M
Total	**1,353**	**11**
Verar Spira	1,134	6
Kuhawar	179	14
Punwar Shumali	28	-
Rao Bela Sharki	11	11

Since Land belongs to Pakgen Power Ltd, documents of intiqals are attached in Pakgen Power Ltd file of "Response to Queries" with Annexure 9.

ANNEXURE' 9"

NEW LAND PURCHASE and DEVELOPMENT COST

Land & Land Development Cost		
	Rs	USD
New Land	50,000,000	514,933
backfilling & Leveling of land	14,000,000	144,181
Boundary wall	20,000,000	205,973
Road Widening	55,000,000	566,426
Additional Housing	250,000,000	2,574,665
Total	**389,000,000**	**4,006,179**
	Million USD	**4.0**

Since land belongs to Pakgen Power Ltd. copies of Integral documents are attached in Pakgen Power file with "Annexure 9"

ANNEXURE'10"

DEVELOPMENT AND CONSTRUCTION COST.

	Development & Construction Management Cost	
	Rs	USD
Feasibility Study, EIA etc.	50,000,000	514,933
Consultants	175,000,000	1,802,266
Financial Advisors	50,000,000	514,933
Office expenses	66,000,000	679,712
Bank Charges for guarantees	20,000,000	205,973
Fee for licenses & permits	10,000,000	102,987
Construction Management cost	600,000,000	6,179,197
	971,000,000	**10,000,000**
	Million USD	**10.0**

Note: The above estimated numbers are based upon our market research for similar costs and preliminary discussion with the consultants/banks

Annexure" 11 "

Calculation of Financial charges of 13.76 Million US$

Capex		Million USD	262
Debt Amount (75% of total Capex)	a	Million USD	196.50
Financing Fee (% of Debt Amount)	b		7.00%
Financial Charges Total	a*b	Million USD	13.76

Annexure "12"

Calculation of ROE of Tariff

Lalpir Power Limited

	unit		
Annual net generation at 100%	kwh		2,885,719,200
Project development costs			
CAPEX	Million USD		262.00
Financial Charges			
Financial fee and charges	Million USD	13.76	
Interest during construction	Million USD	12.60	26.36
Total Project Cost	Million USD		288.36
Exchange Rate per USD	Rs.		97.1
Financial Plan			
Debt foreign	Million USD	75%	216.27
Equity	Million USD	25%	72.09
Equity	Million Rs.		6,999.82
Return on Equity	%		24.5%
Project life	yrs	25	
ROE	Rs. ANNUAL		1,722,147,099
	Rs./kwh		0.5968
	Cents/kwh		0.6146

ANNEXURE "13"

DETAILS OF EXISTING UPDATED CPP

The existing capacity payment will be applicable till the end of existing PPA (i.e. 2028). Escalable component of existing capacity payment is claimed until the end of the existing PPA. Breakup of this component is not available as the 1994 tariff was based on upfront Bulk Power Tariff. However, further details are available in Section 12.6 of the tariff Petition.

In addition, company has claimed FOM only for boiler and its associated costs.

ANNEXURE "14"

JUSTIFICATION FOR USING EXISTING VARIABLE O&M

The company is using the existing O&M cost of RFO for coal. Because company is going to replace only boiler for coal project however remaining major equipment's which is for 365 MW capacity plant like turbine, condenser, Balance of plant, and hydrogen system will remain as it is. Due to this reason, cost of existing plant will not change from existing level so company claiming existing VOM as it is. Please note that this will not increase the tariff and not put any increasing impact on overall electricity price.

ANNEXURE "15"

FIXED O&M FOR CONVERTED COMPLEX

Post 2028 (after the end of the existing PPA tenor), the Company has adopted the fixed O&M as approved by the NEPRA for 350 MW plant. However, till the expiry of existing PPA (2028), the Company claimed additional fixed O&M cost which is only associated with the coal boiler along with the salaries associated with the new employees for additional systems. Detail is available in section 12.6 of Tariff Petition.

Comparison of existing and new tariff and net savings per unit of electricity generated.

Annexure "16"

Lalpir Power Limited

Existing	Proposed	Sa... pe...

Plant Factor	68%	
Estimated Dependable capacity	337	MWH
UNITS AT 60 % Plant fac annual	1771 27	GWH
Days/Year	365	
Hours /day	24	

		Energy Purchase price Rupees/Kwhr			Capacity Purchase Price Rupees/Kwhr			Total	EPP Indexation		EPP Indexed Component		CPP Indexation		CPP Indexed Component		Total Current Tariff indexed
Year	Agreement year	Fuel Component	Variable O & M	Total	Escalable Component	Non-Escalable Component	Total	Rs./KWHr	Fuel Component	Variable O & M	Fuel Component	Variable O & M	Escalable Component	Non-Escalable Component	Escalable Component	Non-Escalable Component	Rs./KWHr
2014	17	8 653	8 03	8 683	8.359	8 849	8 399	1.8829	24 610	5 1811	16 8753	9 1554	5 1811	-	1 8600	9 0400	18 1307
	18	0 653	8 03	8 683	8 359	0 848	8 399	1.8829									
	19	0 653	8 83	0 683	8 359	8 048	0 399	1.9829									
	20	0 653	8 83	8 683	0 359	8 840	9 399	1.0829									
	21	0 653	8 83	0 683	8.359	8 009	9.368	1.8518									
	22	0 653	8 83	8 683	0 359	0 009	9 368	1.8510									
	23	0 653	8 83	8 683	0 359	0 009	0 368	1.0518									
	24	0 653	0 83	0 683	8 359	8 009	8.368	1.0510									
	25	0 663	8 03	0 683	8 359	8 009	8 368	1.0510									
	26	0 653	8 83	0 683	8 359	8 009	8.368	1.0518									
	27	8 653	8 83	8 683	8 359	8 009	8 368	1.0518									
	28	8 653	8 03	0 683	8 359	0 009	0.368	1.0510									
	29	8 653	8 83	8 683	8 359	9 009	0 368	1.8510									
	38	0 653	8 03	0 683	8 359	8 009	0 368	1.0518									

Indexation		Indexation	
Current		Current	
US CPI	128	Fuel Price Average	78.000 b
USD Rate	97 1		
Reference		Reference	
US CPI	74 89	Fuel Price reference	2,843 5
USD Rate	30 03		
Iel	5 18	Iel	24.62

Note: Proposed tariff table is calculated on the bases of current prices so savings have been calculated after indexing existing Tariff table as per current indexation and then by comparing with proposed tariff

Proposed

	EPP Energy Purchase price Rupees/Kwhr			CPP Capacity Purchase Price Rupees/Kwhr			Total
Agreement year	Fuel Component	Variable O & M	Total	Escalable Component	Non-Escalable Component	Total	Rs./KWHr
1	4.7812	8 4654	5.167	2.1397	1.0906	3.230	8.3969
2	4 7812	8 4654	5 167	2 1397	1 0906	3 230	8.3969
3	4 7812	9 4654	6 167	2 1397	1 0906	3 230	8 3969
4	4 7812	8 4654	5 167	2 1397	1 0906	3 230	8.3969
5	4 7812	0 4654	5.167	2 1397	1 0906	3 230	8.3969
6	4 7812	8 4654	5 167	2 1397	1 0906	3 230	8.3969
7	4 7912	8 4654	5.167	2 1397	1 0906	3 230	8.3969
8	d 7812	0 4654	5 167	2 1397	1 0906	3 230	8,3969
9	4.7812	9 4654	5 167	2 1397	1 0906	3 230	8.3969
18	4 7012	8 4654	6 167	2 1397	1 0906	3 230	8.3969
11	4 7012	8 4654	5 167	1 1988	-	1 199	6.3654
12	4 7012	0 4654	5 167	1.1958	-	1 199	6.3654
13	4 7812	0 4654	5 167	1 1988	-	1 199	6.3654
14	4.7812	8 4654	5 167	1 1988	-	1 199	6.3654
15	4 7012	8 4654	5 167	1 1988	-	1 199	6.3654
16	4 7012	8 4654	5 167	1.1988	-	1 199	8,3654
17	4 7812	8 4654	5 167	1 1988	-	1 199	6.3654
18	4 7812	8 4654	5.167	1 1988	-	1 199	6.3654
19	4 7012	8 4654	5 167	1 1988	-	1 199	6.3654
28	4 7912	9 4654	5 167	1 1908	-	1.199	8.3654
21	4 7912	9 4654	5 167	1 1988	-	1 199	6.3654
22	4 7012	9 4654	5 167	1 1988	-	1 199	6.3654
23	4 7812	8 4654	5 167	1 1988	-	1 199	6 3654
2e	4 7812	8 4654	5 167	1 1988	-	1 199	6.3654
25	4 7812	8 a654	5 167	1 1988	-	1 199	6 3654

Rs.

Estimated savings over the life of the project and payback period

Annexure "1

LALPIR POWER LIMITED - COAL BOILER
PROJECT SA[illegible]GS FROM USING COAL IN PALCE OF FURNACE OIL FOR THE YEAR

RUPEES IN MILLION

		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
						1	2	3	4	5	6	7	8	9	10	11
Cash Flows			40%	40%	20.0%											
Cumulative Cash Flows			(2,800)	(2,800)	(1,400)	1,908	1,960	2,015	2,073	2,133	2,197	2,264	2,334	2,407	2,485	2,566
Years			(2,800)	(5,600)	(7,000)	(5,092)	(3,132)	(1,117)	956	3,089	5,286	7,549	9,883	12,291	14,775	17,341
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Payback Period Equity	Years		6.5													
Years			25.00													
Equity			7,000													
ROE	24.50%		24.50%													
Savings																
Local Component						1,722	1,722	1,722	1,722	1,722	1,722	1,722	1,722	1,722	1,722	1,722
Foreign Component			50%			861	861	861	861	861	861	861	861	861	861	861
			50%			861	861	861	861	861	861	861	861	861	861	861
Local																
Foreign Indexed						861	861	861	861	861	861	861	861	861	861	861
Total Savings per annum						1,047	1,099	1,154	1,212	1,272	1,336	1,403	1,473	1,546	1,624	1,705
						1,908	1,960	2,015	2,073	2,133	2,197	2,264	2,334	2,407	2,485	2,566

Idexation

USD Rate	Reference	97.1
USD annual Rate increase		5%

Note: On the bases of current assumptions local and foreign equity has been taken in proportion of 50:50 while at the time of financial close it willl be adjusted as per actual figures.

Estimated savings over the life of the project and payback period

Annexure "17"

13	14	15	16	17	18	19	20	21	22	23	24	25
2030	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**
2,741	2,835	2,933	3,037	3,146	3,260	3,380	3,506	3,638	3,777	3,923	4,076	4,237
22,733	25,568	28,501	31,538	34,684	37,944	41,324	44,830	48,468	52,245	56,168	60,244	64,480
16	17	18	19	20	21	22	23	24	25	26	27	28
1,722	1,722	1,722	1,722	1,722	1,722	1,722	1,722	1,722	1,722	1,722	1,722	1,722
861	861	861	861	861	861	861	861	861	861	861	861	861
861	861	861	861	861	861	861	861	861	861	861	861	861
861	861	861	861	861	861	861	861	861	861	861	861	861
1,880	1,974	2,072	2,176	2,285	2,399	2,519	2,645	2,777	2,916	3,062	3,215	3,376
2,741	2,835	2,933	3,037	3,146	3,260	3,380	3,506	3,638	3,777	3,923	4,076	4,237

Comparison of our proposed Tariff Table with NEPRA's Upfront Tariff table of 350 MW

Annexure 10
Page2/2

NEPRA UPFRONT TARIFF TABLE for 350 MW PLANT WITH FOREIGN FINANCING AND IMPORTED COAL

Comparison

Years 30
Discount Factor 10%
Exchange rato 87.1

Upfront Tariff for Imported Coal Based power plant — Foreign Financing

	Energy Purchase Price (Rs./kw)						Capacity Purchase Price (PKR/KW/Hour)									Cpacity charges	Total Tariff	Total Tariff	Economy	
				Var. O & M			Fixed O A M													
Year	Fuel Component	Ash Disposal	Lime Stone	Foreign	Local	Total EPP	Local	Foreign	Cost of W/C	Insurance	ROE	Debt Repayment	Interest charges	Total CPP	85%	Rs./kwh	cents/kwh	Rs./kwh	cents/kwh
1	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843	1.1490	0.6957	3.6788	4.3280	9.0433	9.3134	0.65	0.67
2	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	8.2276	0.1152	1.1843	1.2070	0.6378	3.6789	4.3281	8.0434	9.3135	0.65	0.67
3	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843	1.2678	0.5769	3.6798	4.3280	9.0433	9.3134	8.65	0.67
4	4.2913	0.22	0.09	0.0684	0.0456	4.7153	8.1535	0.1535	0.2276	0.1152	1.1843	1.3318	8.5130	3.6789	4.3281	9.0434	9.3135	8.65	0.67
5	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843	1.3989	0.4458	3.6786	4.3280	9.0433	9.3134	0.65	0.67
6	4.2913	0.22	0.09	0.0684	0.0456	4.7153	8.1535	0.1535	0.2276	8.1152	1.1843	1.4694	0.3753	3.6708	4.3280	9.0433	9.3134	0.65	0.67
7	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843	1.5435	0.3812	3.6788	4.3280	9.0433	9.3134	8.65	0.67
8	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843	1.6214	0.2233	3.6768	4.3280	9.0433	9.3134	0.65	0.67
9	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	8.2276	0.1152	1.1843	1.7031	0.1416	3.6788	4.3280	9.0433	9.3134	0.65	0.67
10	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843	1.7890	0.0557	3.6788	4.3288	9.0433	9.3134	0.65	0.67
11	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1043			1.8341	2.1578	6.8731	7.0783	0.51	0.52
12	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2278	0.1152	1.1843			1.8341	2.1578	6.8731	7.0783	0.51	0.52
13	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843			1.8341	2.1578	8.8731	7.0783	0.51	0.52
14	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843			1.8341	2.1578	6.8731	7.0783	0.51	0.52
15	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843			1.0341	2.1576	6.8731	7.0783	0.51	0.52
16	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	8.2276	0.1152	1.1843			1.8341	2.1578	6.8731	7.8783	0.51	0.52
17	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	8.2276	0.1152	1.1843			1.8341	2.1570	6.8731	7.0783	0.51	0.52
18	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	8.2276	0.1152	1.1843			1.0341	2.1576	6.8731	7.0783	0.51	0.52
19	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843			1.8341	2.1570	6.8731	7.0783	0.51	0.52
20	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843			1.8341	2.1578	8.8731	7.0783	0.51	0.52
21	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2270	0.1152	1.1843			1.8341	2.1578	6.8731	7.0783	0.51	0.52
22	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2278	0.1152	1.1843			1.8341	2.1578	6.8731	7.8783	0.51	0.52
23	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843			1.8341	2.1570	6.8731	7.0783	0.51	0.52
24	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	8.2276	0.1152	1.1843			1.8341	2.1576	8.8731	7.0783	0.51	0.52
25	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	8.2276	0.1152	1.1043			1.0341	2.1578	6.8731	7.0783	0.51	0.52
26	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843			1.8341	2.1578	6.8731	7.0783	5.87	7.08
27	4.2913	0.22	0.09	0.0684	0.0456	4.7153	8.1535	0.1535	0.2276	0.1152	1.1043			1.8341	2.1578	6.8731	7.0783	5.87	7.08
28	4.2913	0.22	0.09	0.0684	0.0456	4.7153	8.1535	0.1535	0.2276	0.1152	1.1843			1.0341	2.1576	6.8731	7.0703	5.87	7.08
29	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843			1.8341	2.1578	8.8731	7.0783	5.87	7.08
30	4.2913	0.22	0.09	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843			1.8341	2.1578	6.8731	7.0783	6.87	7.08
Average																			
1-10	4.2913	0.2200	0.0900	0.0684	0.0456	4.7153	0.1535	0.1535	8.2276	0.1152	1.1843	1.4401	0.3966	3.6788	4.3280	9.0433	9.3134	0.6464	0.6657
11-30	4.2913	0.2200	0.0900	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	0.1152	1.1843	#DIV/0!	#DIV/0!	1.8341	2.1578	6.8731	7.0783	2.0990	2.1617
1-30	4.2913	0.2200	0.0900	0.0684	0.0456	4.7153	0.1535	0.1535	8.2276	0.1152	1.1843	1.4401	0.3966	2.4490	2.8812	7.5965	7.8234	1.6148	1.6631
1-30	4.2913	0.2200	0.0900	0.0684	0.0456	4.7153	0.1535	0.1535	0.2276	8.1152	1.1843	0.9063	0.2941	3.0365	3.5724	8.2877	8.5352	0.0344	0.8593
	Levelized Tariff (including existing Capacity Payment) =					8.2877	Rs./kWh			8.5352	US Cents/kWh								

Difference 0.5471 0.5634

Working Capital Component Calculation of RFO and Coal

Anne

Lalpir Power Limited

Calculation of Working Capital Component

Coal		Unit	
Gross outpur		MWH	362
Total Net Capacity		MWH	329
HOURS PER DAY		HOURS	24
Thermal Efficiency		%	35.6%
Coal Calorific vaue		LHV	
coal price per M.Ton HHV	Rs./Ton	HHV	12,532
Fuel Cost Component		RS./KWH	4.7012
Fuel Inventory			
Days			90
Load			100%
Daily production		KWH/DAY	7,906,080
Coal Price for days inventory	90	RS.	3,345,094,099
GST			17%
Fuel Price incl. GST		RS.	3,913,760,096
Days in a year			365
Coal Cost Component receivable			
Days			30
Load			100%
Daily Production			7,906,080
Fuel cost receivable for 55 days	55	Days	2,044,224,172
GST			17%
Fuel price incl. gst			2,391,742,281
Total Working Capital Requirement			6,305,502,377
Base Interest Rate			11.91%
Spread			2.00%
Total Interest Rate			13.91%
Cost Of working capital	Annual	RS	877,095,381
Annual Production	100%	KWH	2,885,719,200
Working Capital Component		*Rs./KW/H*	*0.3039*

Calculation of Working Capital Component

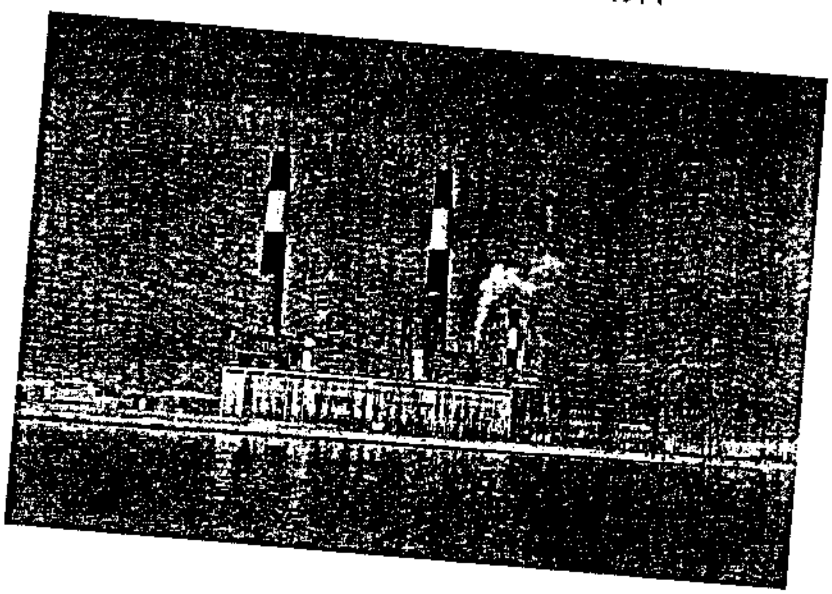
Furnace Oil		Unit	
Gross outpur		MWH	362
Total Net Capacity		MWH	350
HOURS PER DAY		HOURS	24
Thermal Efficiency		%	37.0%
Calorific vaue		LHV	
F.Oil price per M.Ton HHV	Rs./Ton	HHV	70,000
Fuel Cost Component		RS./KWH	17.420 l
Fuel Inuentory			
Days			30
Load			100%
Daily production		KWH/DAY	8,400,000
Coal Price for days inventory	30	RS.	4,389,870,561
GST			17%
Fuel Price incl. GST		RS.	5,136,148,556
Days in a year			365
F.oil Cost Component receivable			
Days			30
Load			100%
Daily Production			8,400,000
Fuel cost receivable for 55 days	55	Days	8,048,096,028
GST			17%
Fuel price incl. gst			9,416,272,353
Total Working Capital Requirement			14,552,420,910
Base Interest Rate			11.91%
Spread			2.00%
Total Interest Rate			13.91%
Cost Of working capital	Annual	RS.	2,024,241,749
Annual Production	100%	KWH	3,066,000,000
Working Capital Component		*Rs./KW/H*	*0.6602*

Furnace oil Fuel cost component calcul		
Data Actual for the period from		Jan-
	unit	
Fuel Consumption	gram	469,6
Generation	kwh	1,9
Consumption	gram/kwh	
fuel cost	Rs	33,5
Fuel cost	Rs. Per gram	
Fuel cost	Rs./kwh	

CdF INGÉNIERIE

LAL PIR POWER LIMITED / PAK GEN POWER LIMITED

2 x 365 MWe POWER PLANTS IN MUZAFFARGARH FUEL CONVERSION



Analysis of tender documents

2014 Jun

Your interlocutor:

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CONTENTS

1 PREAMBLE

Nishat Group has taken initiative to replace HFO fired in its existing oil fired boilers with imported coal.

Both Nishat Group's plants are located in the same site in Punjab / Muzaffar Garh district, Initial company name, raw capacity, first date for commercial operation, are respectively:

- AES LalPir Power Limited, installed capacity of 362 MWe started for commercial operation in November 1997.
- AES PakGen Power Limited, installed capacity of 365 MWe started for commercial operation in February1998.

CdF INGENIERIE is responsible for the management and monitoring of the entire project in under a turnkey contract.

The Economic Operator "EPC" will be responsible for the turnkey contract for the entire operation including the design, supply, transportation, erection / installation, testing and commissioning of the installation.

This analysis offers consists of 8 chapters:

1. The present preamble
2. Candidates who submitted a bid
3. Recall of the project specification
4. Recall of the information to be included in the offers
5. Tender analysis organization
6. Analysis of the submitted offers
7. Price and economy
8. Conclusion

The facilities shall be designed and specified to comply with the requirements of the Power Purchase Agreement and all applicable laws and the national environment quality standards (NEQS).

The whole Works shall strictly comply with the terms, conditions specifications, drawings and other information and data contained in the bidding documents.

2 POTENTIAL EPC BIDDERS

SEC –SAHNGHAI ELECTRIC China and HEI –HARBIN Electric International China - have submitted their complete bids for LALPIR & PAKGEN Coal Conversion projects. However MHI Japan (Mitsubishi Heavy Industries) submitted just budgetary proposal along with some details of plant.

Final proposal submission date was 30 May 2014, and all proposals received within stipulated timeline.

The both bids brief details are presented hereafter:

- **SHANGAI Electric- China**

  Shanghai Electric Group Co., Ltd. is one of the largest diversified equipment manufacturing groups in China. It has the strength of supplying whole sets of equipments, EPC projects and comprehensive service for modern equipments. Since 1990s, its revenue has been always ranking No.1 in China equipment manufacturing industry. In 2010, it realized the sales revenues exceeding 60 billion Yuan and the profits nearly 3 billions Yuan. Now it has over 30,000 employees and nearly 70 subordinates.

  In China, Shanghai Electric is dominant in high-efficiency clean energy, new energy, industrial equipment and industry service, with products covering fossil-fired power unit, nuclear generating unit, wind turbine generator, heavy equipment, power transmission & distribution, rail traffic, elevator, printing & packaging machinery, machine tools, engineering machinery, valve, hydraulic parts, etc.

- **HEI - HARBIN Electric International Co - China**

  Established in 1983, HEI is primarily engaged in the engineering, procurement and construction (EPC) of thermal, hydro and combined-cycle power plants, and the supply of complete sets of equipment; moreover, the company can be contracted to build large-scale transmission facilities and public utilities, and provides professional comprehensive after-sales service.

  HEI has got few experiences, in particular in Asia, for turnkey, or equipment supply and technical services in power plant (coal fired, combined cycles...).

- **MHI –MITSUBISHI Heavy Industries- Japan**

  MHI Group is a corporate group consisting of some 300 domestic and overseas companies. MHI's business activities encompass everything from design, manufacturing, and construction to sales, after-sales service and general services. Synergies are created among group companies as each strives to develop its own strong and unique business.

MHI is an international group well-known all other the world, in particular in Europe, United States, Asia, since few decades.

Furthermore, the Lalpir Power plant was built by MHI, who also signed the contract for the adaptation of steam turbines.

3 PROJECT SPECIFICATIONS – INPUT DATA SYNTHESIS

LAL PIR & PAK GEN wishes to receive bids on engineering, procurement and construction (EPC) basis for the replacement of oil fired boilers (2x1200 ton/hr) built at District Muzaffargarh in Pakistan, by two pulverized coal fired power plants of the same capacity, including:

- The associated coal unloading, storage and coal feeding system.
- The ash handling, storage and disposal systems.
- ESP & Flue gas desulphurisation system
- All related civil, mechanical, electrical and HVAC works and the necessary instrumentation.
- The resolve of all interface and interconnection matters to tie in the new boilers with the existing plants, with its integration in the existing MHI turbines of same capacity, its integration in the existing plant control systems and the plant electrical systems.

The proposed new boilers shall be of the latest and proven technology. They are designed for a minimum of 30 years of design life time, applying best engineering practices from the first perspective for operation, maintenance and have world class performance, to be environmental friendly and to maintain high reliability, availability in their configuration, equipment lay-out, control systems and so forth.

The control system and electrical systems and other equipment should be selected by the Tenderer in a way which not obsolete before 10 years of life.

The scope of supply and of the services here-after "the Works" of the Tenderer (EPC type contract) shall likewise include all elements necessary in order to ensure that the units and all systems and equipments supplied can be operated and maintained throughout the entire range of environmental and operational conditions.

The subject of the scope of supply shall therefore include planning, design, engineering, project management, procurement of equipment and materials, manufacture, construction including labour supervision, temporary facilities and services, and construction equipment, tools and consumables, erection & installation, international and local transportation.

Any temporary works to public highway or facilities require to facilitate transport of equipment and material to site including, reinstatement fees, and compensation, etc... for any disturbances and permits for material movements, testing, quality inspections, initial start-up, tests, inspections for commissioning, Vendor or Supplier assistance and inspection acceptance, functional testing (reliability run), personnel training, documentation and any other supply or service additionally necessary to achieve realization, by way of a "turnkey"-type contractual agreement, of the aforementioned new power plants.

The scope of supply shall also include all consumable (including first filling) required up to PAC. All taxes, custom duties and bank charges, insurance as define in contract, other work packages, services and supplies defined below (such as demolition work, disassembly & removal, relocation, overhauling and repair, modifications, engineering services for obtaining releases, permits and licenses or for ensuring conformity with regulations, etc.) which are necessary in order to achieve realization of the new units, to adapt the power plants to the configuration of the site, or which are required within the scope of the specification.

3.1 INPUT DATA SPECIFIC TD THE SITE

3.1.1 Climatology

Yearly mean dry ambient temperature	26.5 °C
Absolute maximum ambient temperature	50.5 °C
Absolute minimum ambient temperature	-1 °C
Average atmospheric pressure	991.8 mbar
Average wet ambient temperature	21.8 °C
Mean Rain fall	265.4 mm/year

3.1.2 Seismology

Anti-seismic rules from Pakistan will be followed.

3.1.3 Coal characteristics

Imported coal considered for "consumption performances tests" and range of characteristics for design imported coal is South African coal as mentioned in design coal specs of RFP document.

But units shall be able to run with other coal characteristics satisfying emission limits.

3.2 LAYOUT

The EPC Contractor is allowed to adapt the proposed layout according to his studies in respect of several points described in the technical specification.

The boiler will be implanted far from the existing turbine hall and feed water bay. So, length of steam and feed water pipes will increase.

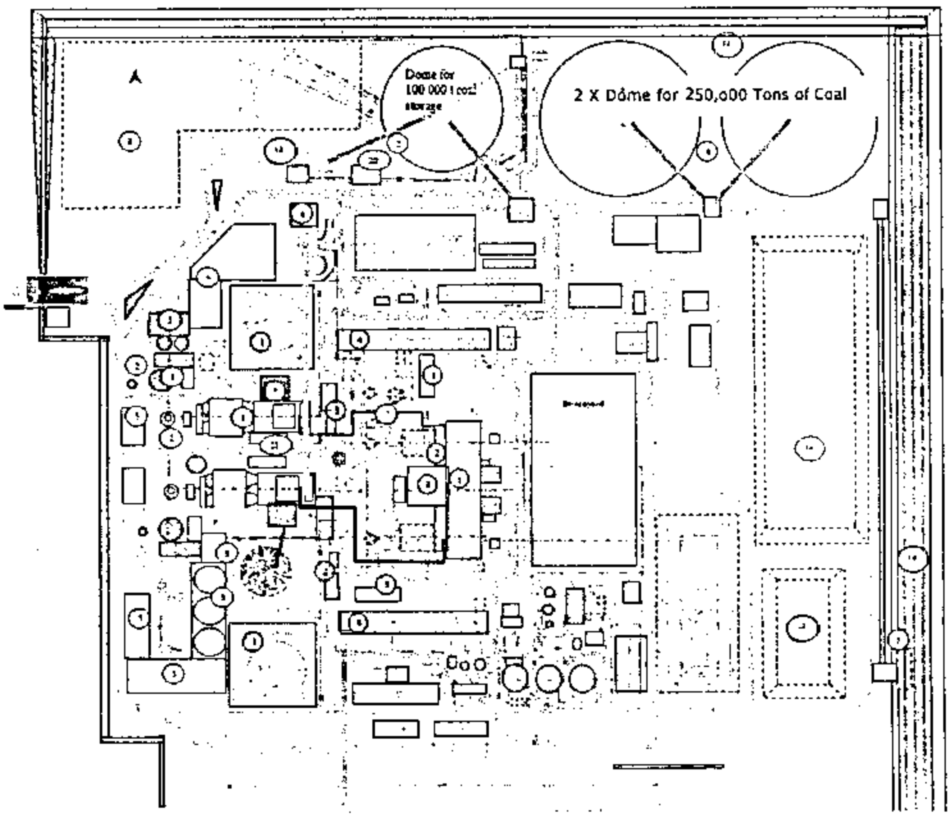
Consequently, EPC Contractor shall propose adapted steam connection lines (adaptation of material, diameter, etc) and if necessary feed water pumps refurbishment or replacement to ensure above requirements. The layout proposal is shown on the below figure.

EPC Contractor was allowed to adapt such layout according to his studies in respect of following main points:

- Train unloading station will be located on East side of power plant.

- New Boilers & ESP will be erected on West side of the power plant.
- Absorber, pumps, raw limestone storage, limestone conditioning, powdered limestone storage, slurry preparation, gypsum dehydration unit, effluent treatment station, gypsum storage capacity and slurry maintenance tank (last tank common to both unit) will be erected between today' s HFO storage area and West dam, together with fly ash silos.

North



South

3.3 REGULATIONS RELATED TO THE PROJECT

The legislation of Pakistan is the applicable legislation.

Yet, for electrical, instrument and control system design, material, test & inspection international standards shall be used like IEC, IEEE, ANSI, NEMA, ASTM, ASME, & NFPA.

3.3.1 Environmental guarantees

3.3.1.1 Emissions to air

Following performances data of foreign banks environmental Guidelines shall be guaranteed in addition to NEQs parameters:

Designation	Units	Emissions limits dry 6% O_2
NOx	mg/Nm^3	510
SOx	mg/Nm^3	850 (*)
Dust	mg/Nm^3	50
Note	*(*) : due to large range of sulphur contain in potential domestic coal which will be used for MIX composition i t will be considered that above guarantee for SOx level will be applicable up to total SOx flow at absorber inlet of....*	

3.3.1.2 Noise

The noise emissions have to comply with the local laws and regulations.

At the power plant boundaries, noise level shall not exceed flowing data:

- Day time Noise Limit (6 a.m. to 10 p.m.): 75 dB(A)
- Night time Noise Limit (10 p.m. to 6 a.m.): 65 dB(A)

3.3.1.3 Process effluents

The following guarantee shall be applicable. This would be as per NEQs & foreign bank's environmental limits.

Designation	Maximal instantaneous content (mg/l)
Temperature	Influent temp. + max 3
pH	6-9
(BOD) 5	80
Total suspended solids - TSS	200
Total dissolved solids - TDS	3500
Oil and grease	10
Chloride as Cl-	1000
Sulphate SO4-	600
Ammonia NH3	40
Sulphide S2-	1
Heavy metals	As specified in EIA

3.3.2 Boiler

3.3.2.1 Boiler nominal characteristics at unit nominal load (100 % MCR)

The design of the boiler will be consistent with the following objectives:

Superheated steam
Flow : 1130 t/h
Pressure : 166.7 bara (169 kg/cm².g) upstream turbine ESV valves
Temperature : 538°C

Feedwater
Temperature: 275°C

Reheated steam
Flow : 895 t/h
Pressure : 36 bara (35,7 kg/cm².g) at turbine inlet
Temperature : 538°C

3.4 PLANT DETAIL

WFGD Wet Flue Gas Desulfurization

Key elements to consider :

- the sulphur content evolution during the switch from international coal to blended fuel with local coal up to about 20% (number of pulverization range, etc),
- to running mode

- Impact of coal range, of fuel oil use
- Water origin and distribution
- Management of flue gas condensation during temporary phases and outage
- Management of blinding risk
- Management of foam formation risk
- Gypsum quality for selling

4. ANALYSIS OF THE SUBMITTED OFFERS

For each offer submitted, verification of its contents vis-à-vis specifications defined in the tender documents is carried out below.

4.1 1ST APPROACH - CONTENT

The **SHANGAI Electric** (SEC) file is more complete and contents:

- A letter of bid submission

- A commercial proposal with 5 appendix :
  1. Schedule of payment
  2. Price breakdown
  3. Commercial clarifications and deviations
  4. Introduction of bidder and financial security statement
  5. Experience and references:
     - SEC reference list
     - Boiler reference list
  6. List of Major subcontractors

- A technical proposal in 7 parts :
  1- Detail technical description
  Deviations requested
  2- Drawings
  3- Construction organization plan
  4- Quality plan & HSE
  5- Test procedure
  6- Training
  7- Spare parts list

It can be noted that items 4 –Quality plan & HSE and 5 –Test procedures have been adapted to the project.

The **HARBIN** Electric **International** (HEI) proposal contents:

- Cover letter
- Price schedule
- Commercial term sheet
- HEI Reference list
- Vendors and subcontractors list
- Technical description and drawings
- Technical comments
- Performance guarantee
- Organization chart
- Construction control plan with a planning curve chart of labor demand
- Project time schedule
- QAQC Manual
- EHS Manual
- Training plan with a schedule

4.2 PERFORMANCE GUARANTEE

Schedule 3 of EPC contract shall be fulfilled by tenderers to evaluate efficiency and performances of proposed equipment.

4.2.1 MHI Japan (Mitsubishi Heavy Industries)

No more information in the MHI offer.

Functional Guarantee	Performance Guarantee requirements
Net electrical output per unit (1)	*to be completed*
Boiler efficiency at following parameters (a) steam water parameters at nominal value, (b) 4 hours stability, © bottom and fly ash extraction stabilized, and (b) blow-down at zero	89%
Unit auxiliary consumption and losses concerning the boiler and all added equipment by the EPC Contractor	Maximum *(to be completed)*
Net heat rate per unit (2)	*to be completed*
Unit minimum Environmental load	*to be completed*
Boiler load range with no need of coal burners support	*to be completed* *% of the nominal load*
Limestone consumption	*to be completed*
Boiler minimum load	*to be completed* *%*
Soot blowing efficiency *The boiler of each Unit shall be able to operate at the guaranteed steam generation and with a frequency of a maximum of one soot blowing per shift.* *The thermal efficiency of the boiler of each Unit shall be kept with a frequency of a maximum of one soot blowing per shift.*	*to be completed*
Soot blowing steam consumption	*to be completed*

It was asked to MHI to complete the table above. But MHI did not showed their interest to submit complete proposal.

4.2.2 SEC - China

Provided boiler main characteristics on MCR load are:

Description	units	Value
Superheated steam outlet flow	t/h	1190
Superheated steam outlet pressure	Kg/cm^2g (bar(a))	178.5 (176)
Superheated steam outlet temperature	°C	541
Feed water temperature	°C	Not indicated
Reheat steam outlet flow	t/h	1197.9
Reheat steam inlet pressure	Kg/cm^2g (bar(a))	38,5 (39)
Reheat steam outlet pressure	Kg/cm^2g (bar(a))	36.5 (36,8)
Reheat steam outlet temperature	°C	541
Reheat steam inlet temperature	°C	332

SEC has partially completed the performance guarantees, by giving boiler gross efficiency, and auxiliary load consumption:

Functional Guarantee	Performance Guarantee requirements
Minimum Boiler efficiency at following parameters (a) steam water parameters at nominal value, (b) 4 hours stability, (c) bottom and fly ash extraction stabilized, and (d) blow-down at zero	**88.5 %**
Minimum duration of stable load without oil support	**40 %** 8MCR

4.2.3 HEI – HARBIN China

Provided boiler main characteristics on MCR load are:

Description	units	Value
Superheated steam outlet flow	t/h	1185
Superheated steam outlet pressure	Kg/cm^2g (bar(a))	178.4 (176)
Superheated steam outlet temperature	°C	541
Feed water temperature	°C	283.3
Reheat steam outlet flow	t/h	978
Reheat steam inlet pressure	Kg/cm^2g (bar(a))	41.3 (41.5)
Reheat steam outlet pressure	Kg/cm^2g	38.3

	(bar(a))	(38.6)
Reheat steam outlet temperature	°C	541
Reheat steam inlet temperature	°C	337.8

HEI has partially completed the performance guarantees, by giving boiler gross efficiency, and auxiliary load consumption:

Functional Guarantee	Performance Guarantee requirements
Minimum Boiler efficiency at following parameters (a) steam water parameters at nominal value, (b) 4 hours stability, (c) bottom and fly ash extraction stabilized, and (d) blow-down at zero	**89 %**
Minimum duration of stable load without oil support	**40 %** Design Coal Firing

4.2.4 Analysis

Considering provided values from the other tenderers, SEC and HEI, submitted net load is very similar (329 MW for SEC, 329.40 for HEI). But HEI gross boiler efficiency is 0.50 % better than SEC which provides to HEI a slight advantage.

To check submitted values, it shall be confirmed some inputs data such as considered feed water temperature. It is observed as well some discrepancies compared to original boiler data (flow rate, pressure temperature of superheated and reheat steam). This shall be detailed during technical clarification exchanges with tenderers.

4.3 SITE MAIN CHARACTERISTICS - COMPARISON

4.3.1 SEC Design conditions

Average Ambient Temperature	26.4 °C
Design Maximum Ambient Temperature	50.5 °C
Design Minimum Ambient Temperature	-1 °C
Average Barometric Pressure	991.8 mbar
Average Relative Humidity	
Design Maximum wind speed	162 km/h
Rain fall	265.4 mm/year

4.3.2 HEI Design conditions

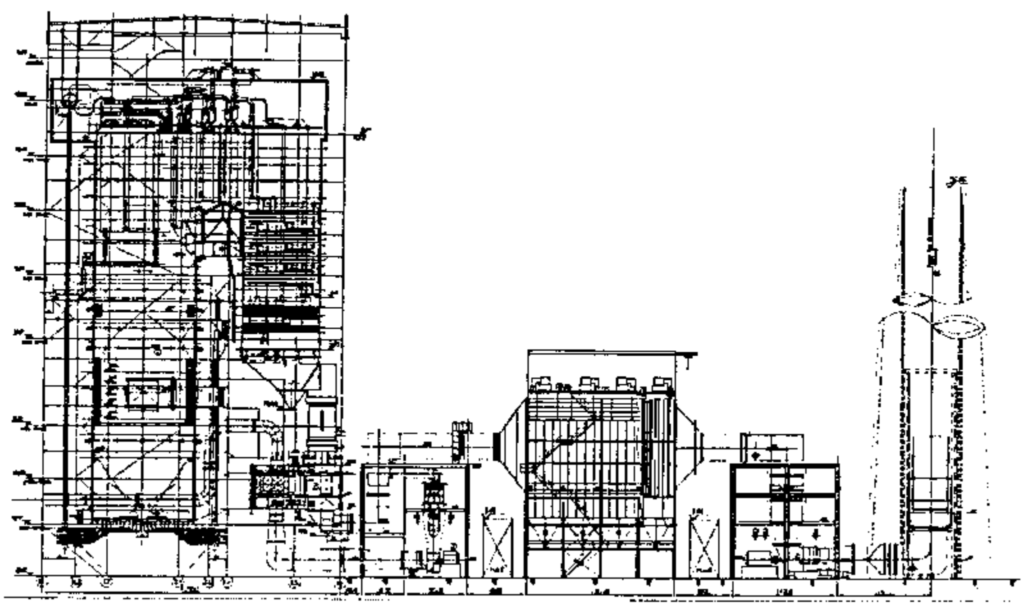
Average Ambient Temperature	26.4 °C
Design Absolute Maximum Ambient Temperature	50.5 °C
Design Absolute Minimum Ambient	-1 °C

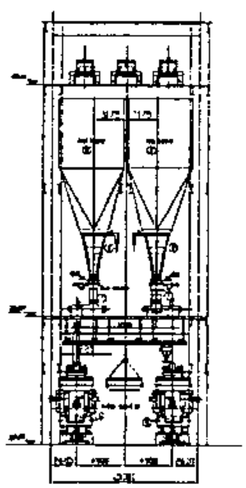
Temperature	
Design Maximum wind speed	45 m/s (162 km/h)
Rain fall	265.4 mm/month

4.4 IMPLEMENTATION ANALYSIS

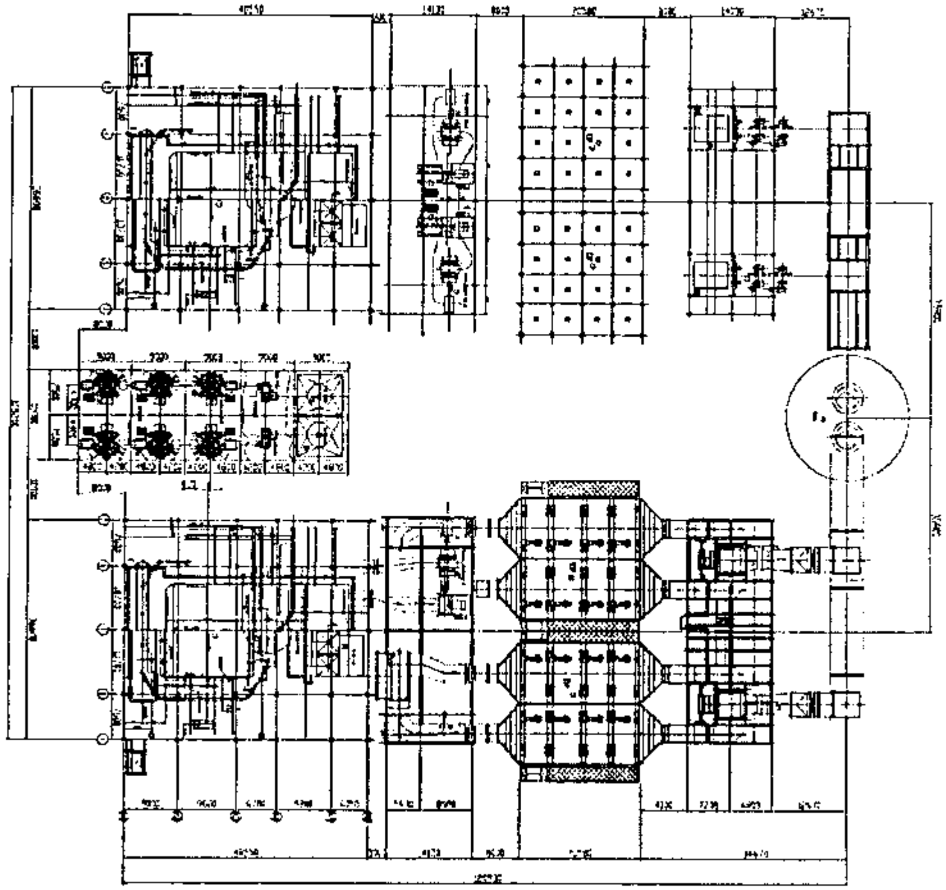
4.4.1 SEC - China

Shanghai Electric proposes the elevation view of the boilers:

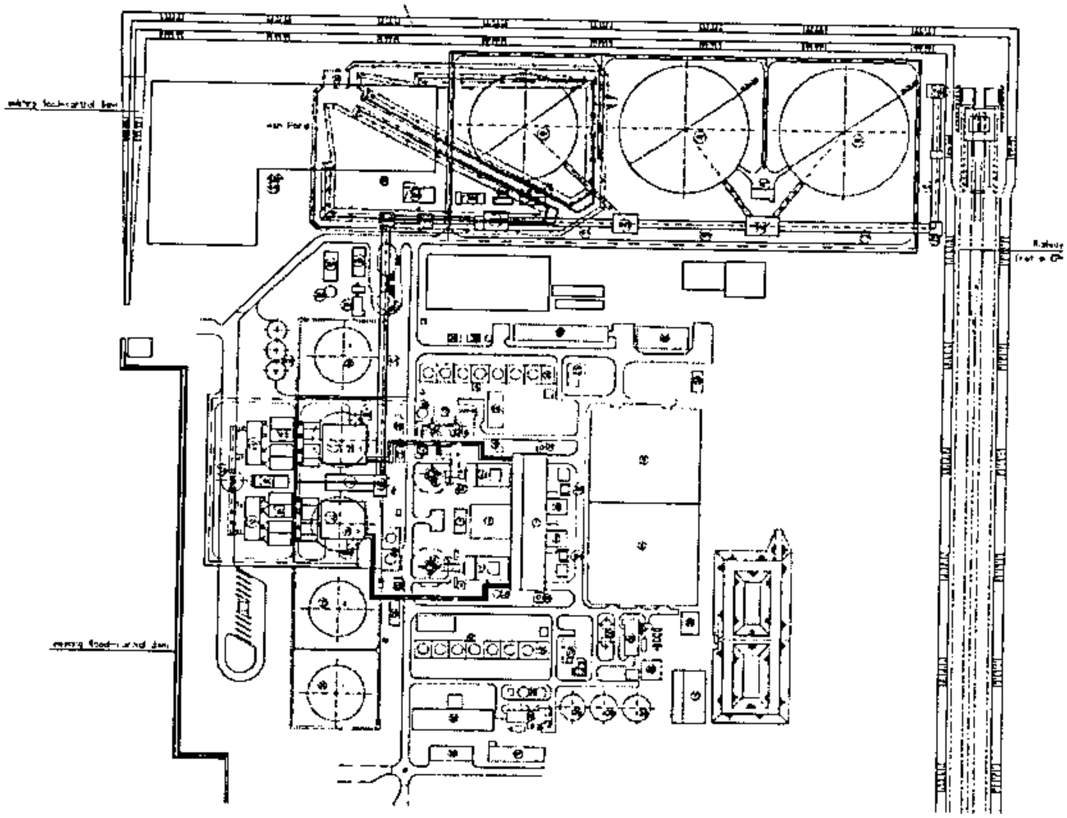




It can be noted that the mills are provided between the two units, which is unusual, but relatively sensible here.



Shanghai Electric proposes the following implementation for the site:



The SEC layout is drawn as follows:

⇒ In the North of the plant : the 3 domes with a capacity of 600 000 t according to the technical specification.

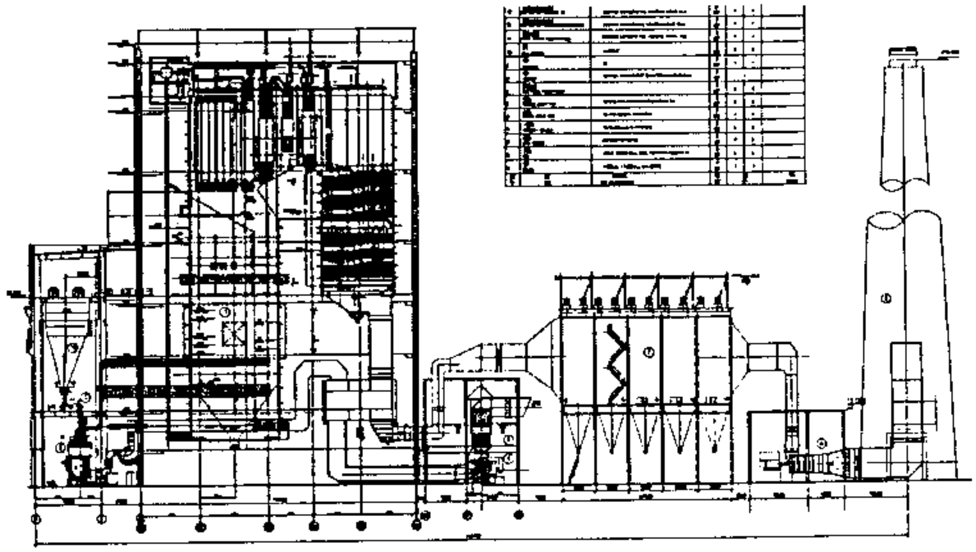
⇒ In the East of the plant : the railway

⇒ In the Northwest of the plant : the ash yard

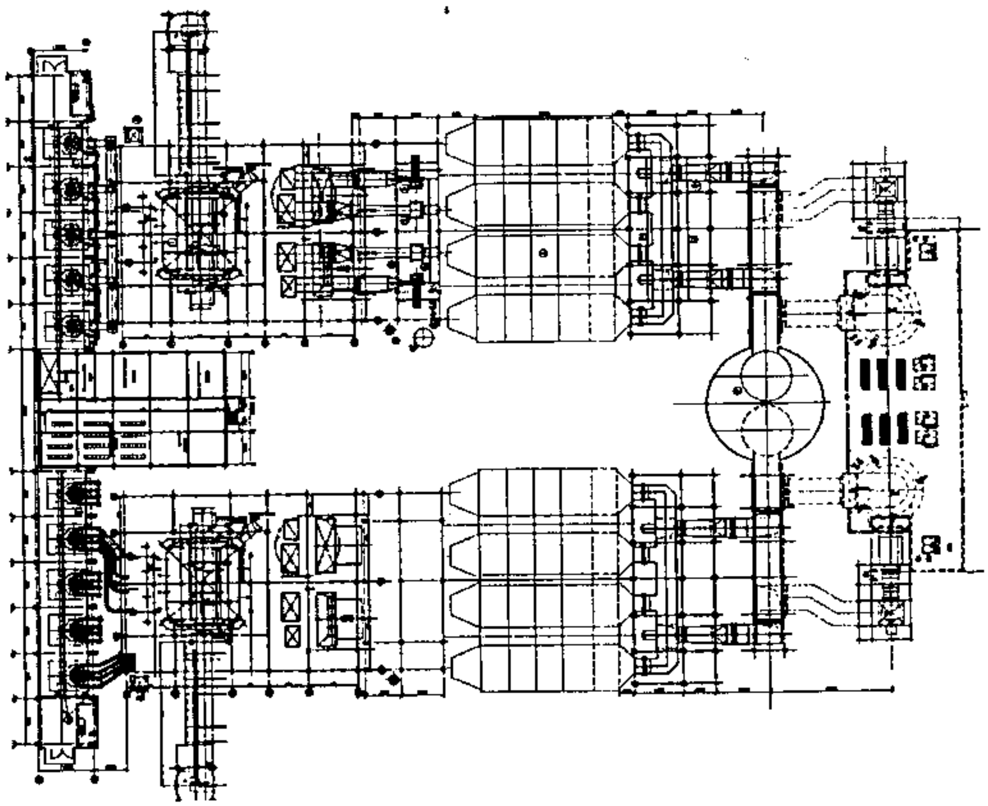
⇒ New boilers are erected instead of HFO tanks 2,3 & 4.

4.4.2 HEI – HARBIN China

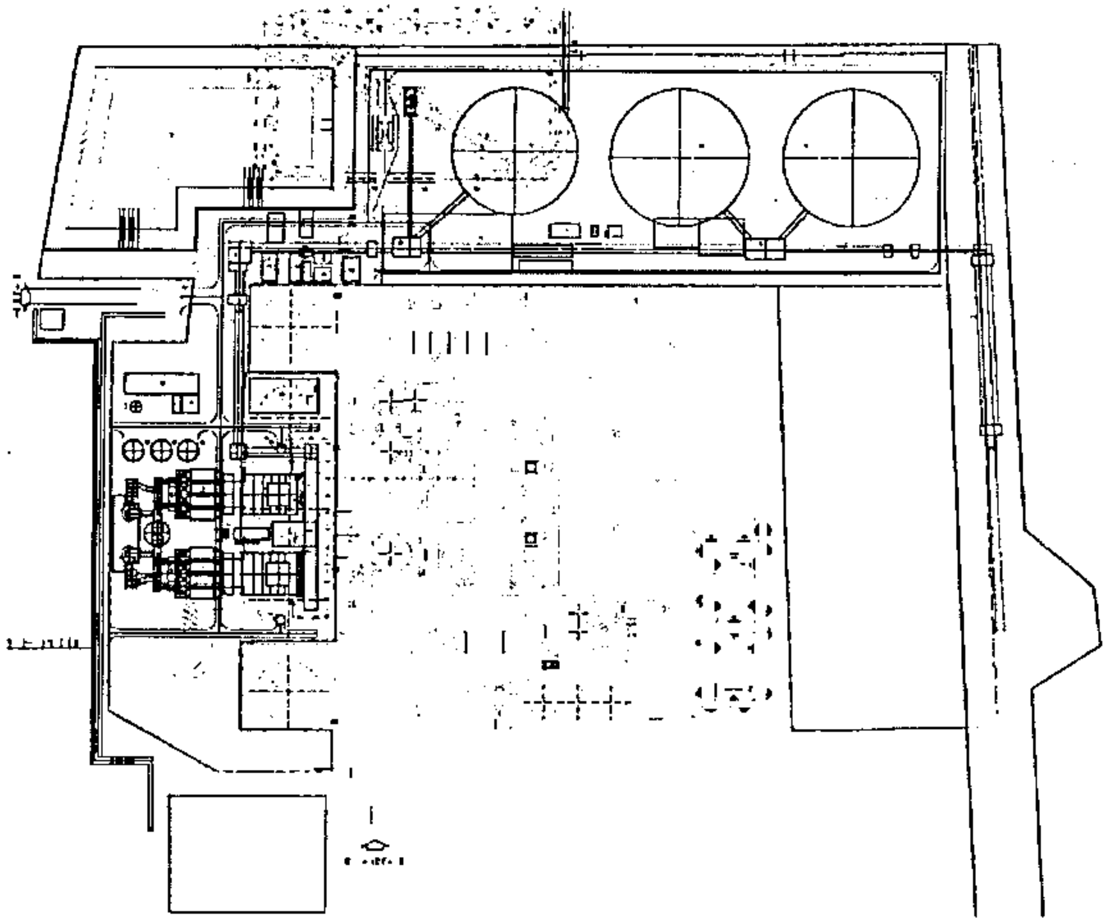
HEI elevation view of the boilers is given here below:



HEI proposal for boiler layout is given here below:



HEI proposes the following implementation:



The HEI layout is drawn as follows:

⇒ In the North of the plant : the 3 domes with a capacity of 600 000 t according to the technical specification
⇒ In the East of the plant : the railway
⇒ In the Northwest of the plant : the ash yard

Boilers are erected instead of HFO tanks 2 & 3 & 4.

4.5 PLANNING

SEC submitted a preliminary planning which indicates a global duration for the project of 36 months for boiler.

HEI submitted a preliminary planning which indicates a global duration for the project of 33-35 months for boiler.

		Notice to proceed		Start of civil work		Sart of steel structure erection		Drum lifting	
		SEC	HEI	SEC	HEI	SEC	HEI	SEC	HEI
Boiler	Months	0	0	10	8	11	14	15	22

		Hydrostatic test		Initial firing		Taking over	
		SEC	HEI	SEC	HEI	SEC	HEI
Boiler	Months	22	27	27	28	36	33

5 PRICE & ECONOMY

The table below summarizes the main information that emerged from the observation of different offers in terms of cost:

Budgetary commercial proposal Comparison

	MHI Japan	**SHANGAI Electric China**	**HARBIN Electric I China**
Indicative price (**USD**) for one plant	**375.626.577**	**259.000.000**	**256.000.000**
Works not included in the scope	*- Extension / reinforcement of protection damps for protection against floods* *- Demolishing work* *- Coal handling system*	-Demolition work	- Demolition work
Schedule: From PO to take-over	Boiler: 41 months	Boiler: 36 months	Boiler: 33 months

6 OFFERS SELECTION SUPPORT

From available data, CdFI remarks are:

SEC and HEI companies provided a completed offer with a process description and a set of preliminary drawings and documents dedicated to the project. Whereas MHI proposal was incomplete and just indicative. Due to higher and incomplete proposal MHI option dropped and here only SEC & HEI proposals concluded.

These companies i.e SEC/HEI have presented quite similar technical offers, based on technical specifications and wisely it can be foreseen the organisation of remaining technical issues clarifications regarding design and scope of supply.

A slight advantage can be given to HEI offer because of a better net thermal efficiency of boilers and less in cost as compared to SEC. This will be confirmed during further exchange in clarifications stage.

Regarding the project schedule, both companies submitted a global preliminary project planning of 36 months, however HEI in view to complete it within 33 months.

Then, based on remarks here above, CdFI recommendations are:

- To focus on SEC and HEI offers. HEI in particular presents advantages technically and economically than SEC.
- To engage detailed clarifications and the review of deviations with HEI particularly.

sojitz

Sojitz Corporation 1-1
Uchisaiwaicho-2chome,
Chiyoda-ku, Tokyo
100-8691, Japan
Date :May 17, 2014
Ref. :

TO: LAL PIR & PAK GEN
Near Mehmood Kot
Muzaffargarh PAKISTAN

Subject : Bid for the replacement of two oil fired boilers by two coal fired power plants

Dear Sirs.

We, thank you very much for your invitation to the captioned subject bid for engineering. procurement and construction (EPC) of the replacement of your oil fired boilers (2x1200 ton/hr) built at District Muzaffargarh in Pakistan, by two pulverized coal fired power plant.

We, the undersigned, are pleased to submit herewith our budgetary proposal as attached for your perusal and consideration.
Although we have a limited time frame and lack of information, we elaborated our budgetary proposal as an original EPC contractor which can be useful for our further discussion and mutual understandings.

The price quoted by us are exclusive of all taxes and duties incurred in Pakistan. For the avoidance of any misunderstandings in future, notwithstanding, details of our proposed contract formation shall be informed to you at later stage, however, which will most likely be split into offshore supply contract and onshore construction contract after mutual agreement with Owner, which please kindly note.

We reiterate that this proposal is for the purpose of our further discussion to elaborate the best suitable modification plan and new installation with technical and commercial viability by taking account of impact on output, heat rate & availability, plant outage periods, owner's expected plant life and the environmental regulation for the success of the completion of the project.

Hoping that we are looking forward to receiving your comment on our proposal shortly.

Very truly yours,

Toshinori Kawahara
Manager, Section No. 4
Plant Project Dept.
Infrastructure Project & Industrial Machinery Unit
Sojitz Corporation

sojitz

Budgetary Commercial Proposal

1. Indicative Price:

JPY 78,500,000,000- (Seventy Eight Billion and Five hundred Million Japanese Yen Only)

Conditions and Remarks:

1: The scope of work and specification is according to our BRIEF TECHNICAL PROPOSAL, Specification No. B-1312-120 (Technical Proposal) as attached.

The following works are not included in the scope of works, because present conditions of site and existing facilities are unknown

(1) Extension and reinforcement of protection damps for power plant protection against floods.

(2) Demolishing work for any existing equipment including heavy fuel storage tanks, existing boiler, FGD and so on

(3) Coal handling system including coal silos, rail lines and train unloading station.

2: The arranged finance for this project shall be able to cover the full amount of the contract price by the international credible bank acceptable to the Bidder.

3: Export credit insurance supported by Japanese Government shall be available for this project and country.

2. Predicted Overall Schedule:

No.1 Boiler unit will be completed at 41month from the commencement of the work.

No.2 Boiler unit will be completed at 47month from the commencement of the work, which shall mean 6 months interval after completion of No.1 Boiler unit.

For more details, please refer to Technical Proposal.

3. Validity:

Not Applicable for this indicative price proposal.

4. Other Terms and Conditions:

Other terms and conditions which are not mentioned in this Proposal shall be discussed and agreed among the parties.

Attachment -1 : Brief Technical Proposal (Specification no. B-1312-120)

<End of Sheet>

LAL PIR POWER LIMITED / PAK GEN POWER LIMITED

2 x 365MWe POWER PLANTS FUEL CONVERSION

BRIEF TECHNICAL PROPOSAL

Specification No. B-1312-120

May 2014

MITSUBISHI
HEAVY INDUSTRIES, LTD.

TABLE OF CONTENTS

1. Preface

This is a technical proposal for modification plan for coal conversion of existing oil firing 365MW x 2 units at Lal Pir / Pak Gen Power Station. This proposal is provided to define the scope of the work for modification plan.

The power station will be a coal fired electric generating station and consist of two (2) coal fired steam generators and accessories, two (2) steam turbine-generators and accessories and the balance of the plant.

The scope of modification plan includes newly installed steam generator, electrostatic precipitator and ash handling system while the existing steam turbines and accessories , balance of plant such as Circulating water system, Raw water and Demi. Water treatment system and Wastewater treatment system will be utilized to extent practically possible.

Two (2) new steam generators will be constructed at heavy fuel oil tank area. The piping of main steam, hot reheat, cold reheat and other necessary piping in boiler side will be connected to turbine side.

Three (3) heavy fuel oil tanks will be demolished while two (2) new coal fired steam generators will be constructed. Other two tanks will be remained.

The specification of system and equipment in this modification plan may be changed according to design condition since it is based on some assumption including coal property.

2. Design Condition

2.1 Meteorologic data

2.1.1 Ambient temperature

Ambient air temperature for design	25 °C
Design maximum temperature	50 °C
Design minimum temperature	0 °C

2.1.2 Relative humidity

Average relative humidity over years	52 %

2.1.3 Rainfall

Maximum rainfall over years	64.5 mm/month

2.1.4 Wind velocity and seismic load

Wind velocity	45 m/s
Seismic load	Zone Factor Z=0.15 as per UBC

2.1.5 Soil Condition

Boiler Structure area	SPT N value N=40
Dther area	SPT N value N=20

2.2 Design Fuel

The boiler will be designed to be capable of burning the coal of which quality is analysis as shown below.

2.2.1 Performance coal

NAME OF COMBUSTIBLE	KLEIN KOPJE
Country	South Africa
DIRECT ANALYSIS	
H20	9
Ashes	14,01
Volatil matter	23,3
Fix carbon	53,69
TOTAL	100
ELEMENTARY ANALYSIS	
H20	9
Ashes	14,01
C	64,79
H	3,55
S	0,55
N	1,55
O	6,55
Cl	0,01
CALORIFIC VALUE	
HCV on raw (kcal/kg)	6200
LCV on raw (kcal/kg)	5954,3
LCV on raw (MJ/kg)	24.93
LCV on raw (kWh/kg)	6.92
ASH ANALYSIS	
SiO2 (A)	48,1
Al2O3 (A)	34,9
Fe2O3 (A)	3,4
CaO (B)	6,3
MgO (B)	0,6
Na2O (B)	0,1
K20 (B)	0,5
SO3	2,5
MnO	0
P2O5	1,7
TiO2 (A)	1,7
TOTAL	99,8
Hardgrove indice	55
ASH FUSIBILITY	
Atmospheric (Red. or Ox.) °C	
Regulation DIN ASTM	
EP IDT	1350
HP ST	
FP HT	1450
FT	1480

2.2.1 Design Coal

NAME OF COMBUSTIBLE	Range
Country	
DIRECT ANALYSIS	
H20	7 to 10
Ashes	10 to 15
Volatil matter	22.5 to 27
Fix carbon	See C in elementary analysis
TOTAL	100
ELEMENTARY ANALYSIS	
H20	7 to 10
Ashes	10 to 15
C	63 to 66
H	3 to 4
S	0.15 to 0.7
N	1 to 3
O	5.5 to 8.5
Cl	0.00 to 0.02
CALORIFIC VALUE	
HCV on raw (kcal/kg)	
LCV on raw (kcal/kg)	
LCV on raw (MJ/kg)	23 to 25.5
LCV on raw (kWh/kg)	
ASH ANALYSIS	
SiO2 (A)	45.4 to 55.5
Al2O3 (A)	27.7 to 35
Fe2O3 (A)	5.3 to 2.7
CaO (B)	4.8 to 8.6
MgO (B)	0.6 to 2.3
Na2O (B)	0.1 to 0.3
K20 (B)	0.5 to 0.6
SO3	2.5 to 6.6
MnO	
P2O5	0.1 to 1.9
TiO2 (A)	1.5 to 1.7
TOTAL	
Hardgrove indice	46 to 55
ASH FUSIBILITY	
Atmospheric (Red. or Ox.) °C	
Regulation DIN ASTM	
EP IDT	
HP ST	> 1 060°C
FP HT	
FT	

Vanadium	mg/kg	39	24	26	35	21	
Copper	mg/kg	19	12	13	16	12	

The mean characteristics 4f International Coal as received ≠ can be estimated as follows:

- Heat value : 6.5 to 7.4 MWh/t or 23.4 to 26.7 GJ/t
- Moisture: 8 to 12 %
- Ash : about 4 to 15.5 %
- VM: 23 to 36 % (even 40%)
- Fixed carbon: 48 to 54 %
- Sulphur: 0.4 to 0.9 %

		IDENTIFIED COAL POTENTIAL IN BALOCHISTAN							
		Sor-Range/Degari (1)		Khost-Sharigh-Harnai-Ziarat (2)		Mach (3)		Duki (4)	
designation	unit	min	max	min	max	min	max	min	max
moisture	%	3,9	18,9	1,7	11,2	7,1	12	3,5	11,5
ash content	%	4,9	17,2	9,3	34	9,6	20,3	5	33,5
VM	%	20,7	37,5	9,3	45,3	34,2	43	32	50
FC	%	41	50,8	25,5	43,8	32,4	41,5	28	42
sulfur	%	0,6	5,5	3,5	9,55	3,2	7,4	4	6
Heating value as received	Btu/lb	11245	13900	9637	15499	11110	12937	10131	14164
	MJ/kg	26,16	32,33	22,42	36,05	25,84	30,09	23,56	32,95
	MWh/t	7,27	8,98	6,23	10,01	7,18	8,36	6,55	9,15
Heating value dry basis	Btu/lb								
	MJ/kg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	MWh/t	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
lignite type		Sub-bituminous		Sub-bituminous		Sub-bituminous		Sub-bituminous	
Coal Reserves total	10^6 tonnes	50		76		23		50	
Measured	10^6 tonnes	15		13		9		14	
Indicated	10^6 tonnes	16		0		14		11	
Inferred	10^6 tonnes	19		63		0		25	
Hypothetical	10^6 tonnes	0		0		0		0	
Measured	%	30,0		17,1		39,1		28,0	
Indicated	%	32,0		0,0		60,9		22,0	
Inferred	%	38,0		82,9		0,0		50,0	

2.2.4 Diesel Oil Analysis

Start up Fuel Properties (HSD)

TEST	TEST METHOD	SPECIFICATION LIMIT
Specific gravity 60/60 F	ASTM D 1298	Max. 0.870
Distillation 90% recovery, °C (°F)	ASTM D 86	Max. 363 (685)
Colour ASTM	ASTM D 1500	Max. 2
Flash point (PMCC), °C (°F)	ASTM D 93	Min. 54 (130)
Sulphur content, % wt	ASTM D 1551/1266	Max. 1.0
Copper strip corrosion 3 hrs. at 50°C (122°F)	ASTM D 130	Max. 1
Viscosity Kinematic 37.0°C (100°F) cst	ASTM D 445	Min. 1.0 Max. 6.5
Cloud point, °C (°F)	ASTM D 97	Max. 6(43)
Pour point °C (°F)	ASTM D 97	Max. 3(37)
Conradson carbon residue on 10% distillation residue, % wt	ASTM D 189	Max. 0.2
Ash, % wt	ASTM D 482	Max. 0.01
Sediment % wt	ASTM D 473	Max. 0.01
Water % Vol	ASTM D 95	Max. 0.05
Cetane number or Cetane index	ASTM D 613 ASTM D 976	Min. 45 Min. 45
Strong acid number mg KOH/g	ASTM D 3242	Nil
Total acid number mg KOH/g	ASTM D 3242	Max. 0.5
Calorific value BTU/Lb	ASTM D 240	Min. 19000

2.3 Design Criteria

2.3.1 Steam Generator

Maximum continuous rating evaporation 1,200t/h	
Steam condition	
Superheater outlet	176 kg/cm²g
	541 C
Reheater outlet	541 · C
Firing system	Pulverized coal firing
Draft system	Balanced draft
Installation	Outdoor

The steam generator will be capable of constant pressure operation.
Target minimum stable load will be 30% MCR, under the assumed coal firing.

2.3.2 Flue Gas Desulphurization System

Flue gas desulfurization system is provided to meet the emission limit 850mg/Nm³ (dry. 6%O2).

2.3.3 Electrostatic Precipitator

Electrostatic precipitator is provided to meet the emission limit 50mg/m³N.

2.3.4 Net Electrical Power Output and Efficiency

Due to the additional equipment such as Flue Gas Desulphurization System, Electrostatic Precipitator, Ash Handling System, Pulverizers and Induced draft fans as being coal firing power plant, decrease in net electrical power sent out is envisaged. Further study is required to determine the auxiliary power consumption of the Plant after the modification work. Plant net efficiency also decreases accordingly.

3. Scope of Work

3.1 General

(1) The scope of plan will be to construct two (2) new coal firing steam generators and ancillary, on full turn-key basis, which covers engineering, design, material procurement, fabrication, testing at shop, packing and delivery to the site, erection, testing at site and commissioning.

(2) Extension and reinforcement of protection damps for power plant protection against floods is not included in scope of supply.
Armed security service during construction work, such as armed security guards, barricade for armored vehicle, counterterrorism, and coordination with arms/polices, etc. are not included in scope of supply.
Soil improvement work against required design condition as mentioned in section 2.1.5. is not included in scope of supply.

(3) The demolishing work for any existing equipment such as heavy fuel storage tanks, existing boilers, FGD and so on shall be done by Others.

(4) Equipment which needs to be relocated for the execution of the modification work will be done by Others.

(5) In case any existing system/Equipment are utilized for coal conversion, these are marked as 'Existing' in the following list. However it is for preliminary at this stage and may be changed according to the further study and the actual site condition.

(6) Coal handling system including coal silos is not in scope of supply.

(7) The scope of work in the proposal is limited in the area enclosed by the red dotted line in the attached plot plan no.H20-001.

Existing : Existing equipment/system will be used.
Newly installed : New equipment will be installed.
Replaced : Existing equipment will be replaced by newly installed equipment.

3.2 Boiler and ancillary

(1) Boiler

(a)	Boiler drum and internal	Newly installed (1 set / unit)
(b)	Furnace lower header and orifice	Newly installed (1 set / unit)
(c)	Water wall, header & conn. pipe	Newly installed (1 set / unit)
(d)	Superheater, header conn. pipe and desuperheater	Newly installed (1 set / unit)
(e)	Reheater, header conn. pipe and desuperheater	Newly installed (1 set / unit)
(f)	Economizer, header and conn. pipe	Newly installed (1 set / unit)
(g)	Boiler water circulating pump	Newly installed (2 sets / unit)
(h)	Casing, refractory and insulation	Newly installed (1 set / unit)
(i)	Air preheater	Newly installed (2 sets / unit)
(j)	Soot blower - Long retractable soot blower - Wall deslagger	Newly installed (1 lot / unit)

(2) Draft equipment

(a)	Forced draft fan and silencer (including motor)	Newly installed (2 sets / unit)
(b)	Induced draft fan (Including motor)	Newly installed (2 sets / unit)
(c)	Primary air fan (including motor)	Newly installed (2 sets / unit)
(d)	Air and gas duct	Newly installed (1 set / unit)
(e)	Seal air fan (Including motor)	Newly installed (2 sets / unit)
(f)	Cooling fan (Including motor)	Newly installed (2 sets / unit)

(3) Coal firing equipment

(a)	Coal bunker	Newly installed (5 sets / unit)
(b)	Coal gate	Newly installed (5 sets / unit)
(c)	Coal feeder	Newly installed (5 sets / unit)
(d)	Pulverizer (Including motor) and pyrite hopper	Newly installed (5 sets / unit)
(e)	Coal chute	Newly installed (5 sets / unit)
(f)	Coal pipe and coal valve	Newly installed (20sets/ unit)
(g)	Coal burner	Newly installed (20sets/ unit)
(h)	Burner wind box	Newly installed (4 sets / unit)

(4) Light oil firing equipment

(a)	Light oil burner	Newly installed (4 sets / unit)
(b)	Light oil igniter	Newly installed (20sets for coal burner) (4 sets for oil burner)

(5) Miscellaneous equipment

(a)	Chemical dosing equipment	Existing
(b)	Steam and water sampling apparatus	Existing
(c)	Boiler yard elevator	Newly installed (1 set / unit)

(6) Pipe, valve and fitting

(a)	Main steam piping	Newly installed	(1set /unit)
(b)	Hot reheat steam piping	Newly installed	(1set/unit)
(c)	Cold reheat steam piping	Newly installed	(1set/unit)
(d)	High pressure feed water piping	Newly installed	(1set/unit)
(e)	Boiler drain and venting system	Newly installed	(1set/unit)
(f)	Desuperheater spray water piping	Newly installed	(1set/unit)
(g)	N2 gas seal piping	Newly installed	(1set/unit)
(h)	Auxiliary steam and drain piping	Newly installed	(1set/unit)
(i)	Air heater washing water piping	Newly installed	(1set/unit)
(j)	Bearing cooling water piping	Newly installed	(1set/unit)
(k)	Service and control air piping	Newly installed	(1set/unit)
(l)	Drainage and waste water piping	Newly installed	(1set/unit)

(7) Painting and insulation

(a)	Paintings	Newly installed (1 set / unit)
(b)	Lagging and cladding for equipment, pipe work and ducting	Newly installed (1 set / unit)

(8) Steel structure for boiler and ancillary plant

(a)	Boiler supporting structure including	Newly installed (1 set / unit)

(c)	Elevator shaft with its enclosure	Newly installed (1 set / unit)
(d)	Duct support structure	Newly installed (1 set / unit)
(e)	ESP supporting structure including unit) interconnected walkways, platforms and stairways	Newly installed (1 set /
(f)	Outdoor pipe racks	Newly installed (1 set / unit)

3.3 Stream Turbine and Auxiliary

(1)	Turbine	Existing
(2)	Condensing plant	Existing
(3)	Feed water heating plant	Existing
(4)	Boiler feed pump	Existing (Replacement may be required according to further study.)
(5)	Pipe, valve, fitting and support	Existing

3.4 Generator and Electrical Equipment

(1) Generator and auxiliaries

(a)	Generator with complete accessories	Existing
(b)	Hydrogen storage system	Existing
(c)	PT and surge absorber cubicle	Existing
(d)	Neutral grounding equipment	Existing
(e)	Isolated phase bus duct	Existing and partially replace

(2) Transformer

(a)	Generator step-up transformer with accessories	Existing
(b)	Start-up auxiliary transformer with accessories	Replace (1set / unit)
(c)	Unit auxiliary transformer with accessories	Replace (1set / 1 unit)

(3) Switchgear

(a)	11 kV unit switchgear	Existing and Newly installed
(b)	Neutral grounding device for unit auxiliary transformer	Newly installed (1set / unit)
(c)	Neutral grounding device for start-up auxiliary transformer	Newly installed (1set / unit)
(d)	400 V power center with auxiliary transformer for unit and common service	Existing
(e)	11 kV/400 V auxiliary transformer for boiler MCC control center	Newly installed (1set / unit)
(f)	400V motor control center installed and distribution board for unit and common service	Existing and Newly

(4) DC power supply and UPS system

(a)	220 VDC battery and charger	Existing and Newly installed
(b)	Inverter for control	Existing and Newly installed

(6) Diesel generator	
Diesel generator set with associated equipment	Existing
(7) Communication system	
(a) Telephone system	Existing and Newly installed
(b) Paging system	Existing and Newly installed
(c) Clock system	Existing and Newly installed
(8) Cable and ancillaries	
(a) Power and control cables, cable trays, cable conduits	Existing and Newly installed
(b) Lighting system including lighting fixtures, distribution panel, switches etc.	Existing and Newly installed
(9) Electrical control and protection	
(a) Station electrical control panel	Existing
(b) Generator and transformer protection relay panel	Existing
(c) Station transformer protection relay panel	Existing
(d) Generator auto-synchronizer panel	Existing
(e) Electric transducer panel	Existing
(f) 220kV substation control panel	Existing
(g) Protection relay panel for 220kV substation	Existing
(10) 220kV substation	Existing

3.5 Instrument and Control

Followings show instrument and control system of newly installed equipment such as boiler. It is assumed that I&C system of the existing equipment which are utilized for coal conversion such as steam turbine will be utilized.

(1) DCS and control system such as Automatic Boiler Control system, Burner Management system, etc.	Expansion of Existing
(2) Operator Station with desk (Necessary S/W will be added.)	Expansion of Existing
(3) Data acquisition system (Necessary S/W will be added.)	Expansion of Existing
(4) Interlocks and protection system	Expansion of Existing
(5) Field instrument	Newly installed
(6) Interlocks and protection system for utilized equipment	Expansion of Existing

3.6 Water Treatment Plant

(1) Well water intake plant	Existing
(2) Circulating water plant	Existing
(3) Auxiliary cooling water plant	
(a) Auxiliary cooling water pump and motor	Existing
(b) Bearing cooling water piping	Existing and Newly installed

Outdoor hydrant system shall be extended to new boiler area and coal yard.
The necessary system for coal handling control/electrical house and No.1 and No.2 boiler control/electrical house will be newly installed.

(5) Potable water system — Existing

(6) Service water plant — Existing
Service water piping shall be extended to new boiler area and coal yard.
The booster pump for newly installed boiler may be required.

(7) Demineralization plant — Existing

(8) Chlorination plant — Existing

(9) Wastewater treatment plant — Existing
Waste water piping shall be extended to new boiler area and coal yard.
The drain pumps around newly installed boiler may be required.

3.7 Fuel Oil Plant

(1) Diesel oil storage tank	Existing
(2) Diesel oil unloading station	Existing
(3) Diesel oil supply pump	Newly installed (2 sets / unit)
(4) Ignition light oil pump	Newly installed (2 sets / unit)
(5) Light oil suction strainer	Newly installed (2 sets / unit)

3.8 Station Common Equipment

(1) Compressed air plant	Existing
(2) Overhead crane	Existing
(3) Lifting hoist	Existing and Newly installed
(4) Auxiliary boiler	Existing
(5) Workshop	Newly installed
(6) Laboratory	Existing

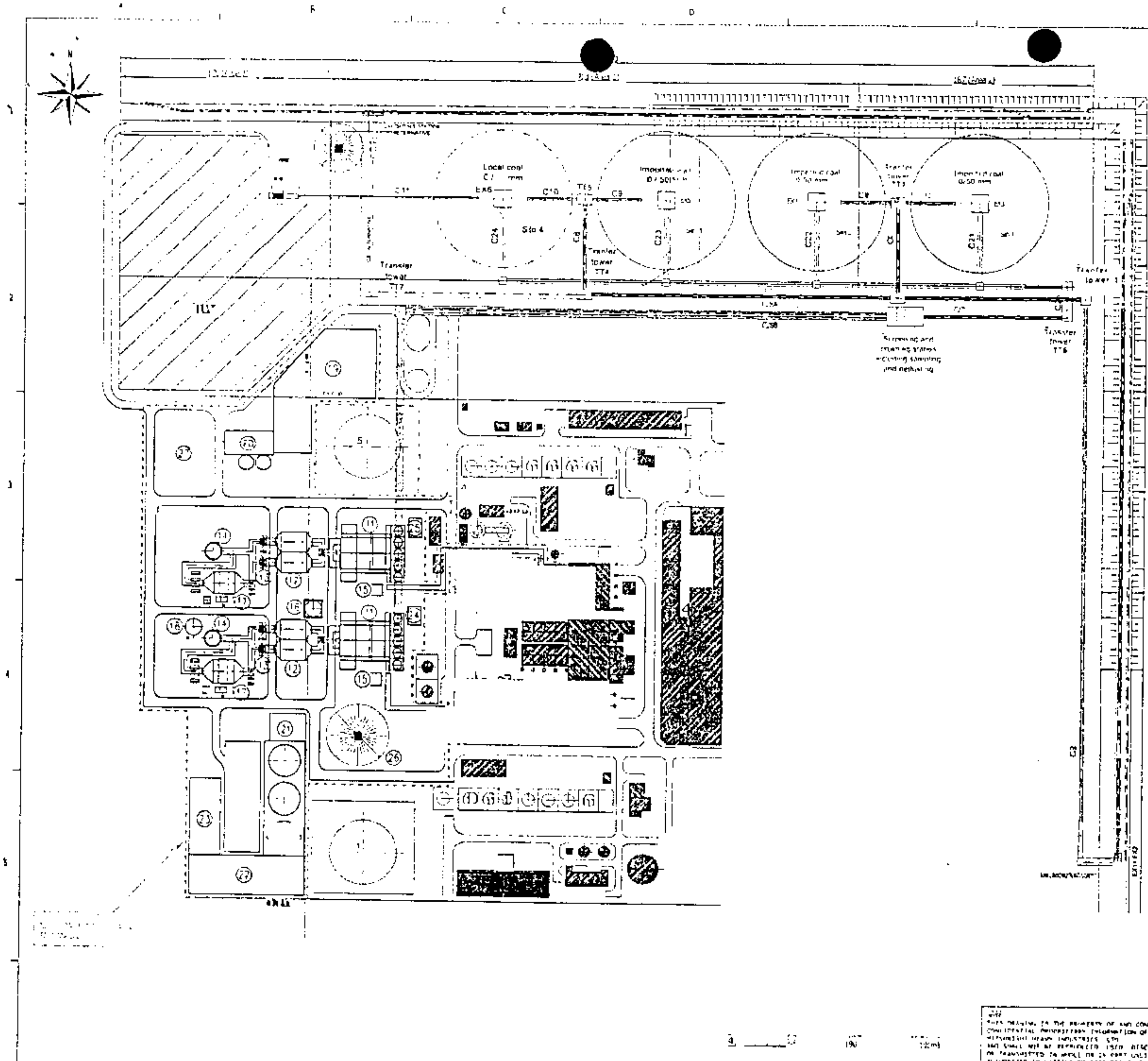
3.9 Ventilation and air conditioning — Existing

3.10 Ash Handling Plant

(1) Bottom ash handling equipment

Drag chain conveyors (Dry type or Wet type)	Newly installed (1 set / unit)
Clinker crushers	Newly installed (1 set / unit)

(2) ECO, AH, and ESP fly ash pneumatic vacuum conveying equipment



NO.	DESCRIPTION
[illegible]	COAL FIRED STEAM GENERATOR
[illegible]	ELECTROSTATIC PRECIPITATOR (OPTION 1)
[illegible]	INDUCED DRAFT FAN
[illegible]	STACK
[illegible]	BOTTOM ASH STORAGE AREA
[illegible]	FLY ASH INTERMEDIATE TANK (COMMON)
[illegible]	FLUE GAS DESULPHURIZATION SYSTEM (OPTION 2)
[illegible]	EMERGENCY STORAGE TANK (OPTION 2)
[illegible]	LIMESTONE STORAGE
[illegible]	LIMESTONE PREPARATION
[illegible]	FLY ASH SILO
[illegible]	GYPSUM STORAGE
[illegible]	WORKSHOP & STORE
[illegible]	UNIT 1 BOILER CONTROL/ELECTRICAL BUILDING/ASH HANDLING HOUSE
[illegible]	UNIT 2 BOILER CONTROL/ELECTRICAL BUILDING/ASH HANDLING HOUSE
[illegible]	ASH YARD
[illegible]	HEAVY FUEL OIL UNLOADING AREA

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

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LAL PIR POWER LIMITED/ PAK GEN POWER LIMITED
[illegible] POWER PLANTS FUEL CONVERSION
PLOT PLAN
SCALE 1:1500
201 3066E
H20-001
0

MITSUBISHI HEAVY INDUSTRIES,LTD.

H20-001

DESCRIPTION

KEY SCHEDULE

RUNNING MONTH

REMARKS:

The above schedule is the summary one based on the MHI's experience of newly installed similar sized steam generators including the commissioning work using only 1 kind of coal. No demolishing work is considered into the above schedule. In case any condition is changed from the assumptions which are the basis of the above schedule, the above schedule shall be changed accordingly.

PRELIMINARY

APPROVED

CHECKED

DRAWN

Lal Pir Power Ltd. / Pak Gen Power Ltd.

Lal Pir / Pak Gen Power Station
2x365MW Coal Fired Steam Generators

OVERALL SCHEDULE

ORDER	DRAWING NO.	REV. NO.
	SPY130518	0

上海电气
SHANGHAI ELECTRIC

FORMAT OF LETTER OF BID SUBMISSION

Date: May. 21, 2014

Subject: Bid for the replacement of two oil fired boilers by two coal fired power plants

Dear Sirs,

Having examined the Tender Documents dated Jan.22 ,2014 (as amended up-to date) issued by LAL PIR & PAK GEN (the "Owner"), we, the undersigned, offer to perform all works and services and to provide all goods, equipment and materials in compliance with the Tender Documents and our technical proposal, for each project amount USD 259,000,000 (Two Hundred and Fifty Nine Million only) the total amount of two projects USD 518,000,000 (USD Five Hundred and Eighteen Million only, and the price quoted is inclusive of all taxes and duties in the country of origin and exclusive of all taxes in Pakistan.), the optional FGD amount shall be USD 32,000,000(USD Thirty Two Million only) .

We confirm that we have understood the requirements of the Project after having carried out a thorough review of the Tender Documents and other documents. We have satisfied ourselves with regard to all matters which could affect our Bid and have taken all necessary advice in this regard. We agree to be bound in all respects by the terms and conditions set out in the Tender Documents and bidding documents.

All the demolition work, disassembly & removal, relocation, overhauling and repair, modifications, construction of railways, site clearing & area leveling, foundation treatment and project insurance are excluded.
The works of piping, painting, insulation, storage, labeling and packing will be as per Chinese Standards.

If our Bid is accepted, we undertake to carry out all our obligations under the EPC Contract strictly in accordance therewith, and to ensure that the Project satisfies the tests on completion and achieves guaranteed performance within the time for completion.

We agree and undertake to execute the EPC Contract within such period as offered by us.

By virtue of submission of this letter to the Owner, we will be deemed to have acknowledged, accepted and agreed to the following conditions and given the following undertakings, representations and warranties in favor of the Owner:

•We shall defend, indemnify and hold harmless the Owner and nominees from any and all losses, liabilities, damages and expenses incurred, suffered, sustained or required to be paid, directly or indirectly, by, or sought to be imposed upon, the Owner and nominees in consequence of any breach or non-performance by us of any of our obligations under or pursuant to the Tender Documents or any agreement executed there-under or pursuant thereto, subject to the terms and conditions of final Contract;

•We have the full power, authority and legal right to participate in the Bidding process as contemplated in the Tender Documents and to perform our obligations to execute and deliver the EPC Contract and to perform and observe all the terms and conditions set forth in the Tender Documents;

•All statements and evidence provided by the Bidder to the Owner under this Bid and otherwise remains true and correct, unless otherwise intimated in writing to the Owner;

•All acts, conditions and things required to be done, fulfilled and performed in order to enable us lawfully to enter into, perform and comply with the obligations expressed (or proposed) to be assumed by us under or pursuant to the Tender Documents have been or, where applicable, shall be done, fulfilled and performed in accordance with all applicable laws;

•Our representative(s) have been duly authorized to act for and on our behalf and the Bid and all documents in connection therewith submitted on our behalf and any other documents executed by such representatives on our behalf shall be fully binding on us;

•The execution, delivery and performance of any of the documents required to be executed by us under or pursuant to the Tender Documents do not and will not (i) violate any provisions of any existing law, decree, regulation, ordinance or similar enactment that applies to us; or (ii) violate any existing decision or judgment of any court or other tribunal or regulatory authority or any arbitral award in each case binding on us; or (iii) violate or contravene any existing agreement or other instrument to which we are a party or which is binding on us;

•No litigation or arbitral or administrative proceeding is pending or, to our knowledge (after due and careful enquiry), threatened against us being litigation or proceedings which materially an adversely affects our ability to observe or perform any of our obligations under or pursuant to the Tender Documents and the EPC Contract;

•No event has occurred which constituted, or which with the giving of notice and/or the lapse of time and/or a relevant determination would constitute, a contravention of or default or breach including, without limitation, under any agreement, instrument, law, facility, credit arrangement, guarantee, mortgage, bond, note, indenture, deed, judgment, order, license, permit, consent or obligation by which we are bound or affected, being a contravention or default which materially and adversely affects or could not affect our ability to observe or perform our obligations under or pursuant to the Tender Documents and the EPC Contract;

•We irrevocably and unconditionally accept and agree that the Owner reserves the right to accept or reject any offer or Bid, to modify or terminate the Project as contemplated in the Tender Documents. Without prejudice to the generality of the foregoing, if any unforeseen circumstance or situation which might affect the Project should arise, the Owner reserves the right to determine, at its sole and absolute discretion, how such event will be resolved;

•We have observed the highest standard of ethics during all stages of the Project contemplated in the Tender Documents and have not engaged in corrupt or fraudulent practices during such time. Any effort by a Bidder to influence the Owner or any employee or advisor (or any affiliates, subsidiaries and agents of the foregoing) thereof in connection with the Bidding process or otherwise in connection with the Project contemplated in the Tender Documents shall result in our disqualification; and

The Bid is valid for the period of six month from the date of this offer.

Should you have question, please do not hesitate to let us know.

Sincerely yours,

俞莉雯

Yu Liwen
General Manager of Div.1
Sales & Marketing Department
SECPG, EPC

LAL PIR & PAK GEN POWER PLANTS
FUEL CONVERSION PROJECT

TECIINICAL DESCRIPTION

Shanghai Electric Group Co.LTD

Southwest Electric Power Design Institute

May, 2014

INDEX

SECTION 1 GENERAL SUMMARY

1.1 Project Brief

Nishat Group has acquired AES Lal Pir Pvt. Limited and AES Pak Gen Pvt. Company. Each plant has gross capacity of 365 MW.

They are situated Near Mahmud Kot, Qasba Gujrat, Tehsil Kot Addu District Muzaffargarh, in the Province of Punjab, Pakistan.

The conversion will be installed two PC Boilers and relative BOP, followed by the requirements of the Technical Specification.

1.2 Standards and Codes

Chinese GB and equivalent international standards will be compliant for Construction, Equipment, Operation, Maintenance, etc.

1.3 Seismic Information

The Power Plant is in the seismic zone 2A.

Peak ground acceleration associated with zone 2A has been recommended to vary from 0.08 g to 0.16g. A maximum earthquake design factor of 0.16g will be utilized for the design of plant building & structures.

The probabilistic analysis for Pakistan shows that expected peak ground acceleration with 10% probability of exceedance in 50 years at site is about 0.16g.

1.4 Ambient Conditions

The Plant shall be designed on the basis of the ambient conditions the "Reference Conditions" as given below:

Average Ambient Temperature	26.4°C
Design Maximum Ambient Temperature	50.5°C
Design Minimum Ambient Temperature	-1°C
Average Barometric Pressure	991.8mbar
Average Relative Humidity	19.9%
Design Maximum wind speed	162 km/h
Rain fall	265.4mm/y

1.5 Coal Analysis

For this bidding technical description, the imported coal will be the coal source of the power plant, and the boiler and the auxiliaries will be designed by the import coal data. The design coal characteristics of the import coal will be followed the appendices *AP-03-31-Solids liquid fuels*. For the check coal of the import coal, it is not provided in the Owner"s Technical Specification and Appendices. so it will be defined by the following, according to the appendices *AP-03-31-Solids liquid fuels*.

Considering the ESP and WFGD system extension in the future, the blending coal (imported coal with domestic coal, the ratio is 4:1) will be assumed.

1.5.1 Design coal (imported coal, as performance coal)

The design coal analysis supplied by owner is as follows:

Coal Specification of design coal		
		Average Quality
A	Proximate Analysis	
i	Moisture (a.r) %	9
ii	Ash (a.r) %	14.01
iii	Volatile Matter (a.r) %	23.3
iv	Fixed Carbon (a.r) %	53.69
B	Calorific Value	
	Low Calorific value (kj/kg)	24930
C	Ultimate Analysis	

Coal Specification of design coal		
		Average Quality
i	C (a.r) %	64.79
ii	H (a.r) %	3.55
iii	N (a.r) %	1.55
iv	O (a.r) %	6.55
v	S.t (a.r) %	0.55
D	Ash analysis (% of Wt -dry basis)	
i	Silica(as Sio2)	48.1
ii	Alumina(as Al2O3)	34.9
iii	Iron oxide(as Fe2O3)	3.4
iv	Titanium oxide(as TiO2)	1.7
v	Phosphorus oxide(as P2O5)	1.7
vi	Sulphur oxide(as SO3)	2.5
vii	Calcium oxide(as CaO)	6.3
viii	Magnesium oxide(as MgO)	0.6
ix	Sodium oxide(as Na2O)	0.1
x	Potassium oxide(as K2O)	0.5
xi	others	0.2
E	Ash fusibility characteristic	
i	Initial deformation temperature (deg C)	1350
ii	Softening temperature (deg C)	-
iii	Fluid temperature (deg C)	1480
F	Hardgrove grindability index (HGI)	55

1.5.2 Check coal (imported coal, for reviewing the capacity of auxiliaries)

The check coal analysis is assumed as follows:

Coal Specification of check coal		
		Average Quality
A	Proximate Analysis	
i	Moisture (a.r) %	12
ii	Ash (a.r) %	15.5
iii	Volatile Matter (a.r) %	23
iv	Fixed Carbon (a.r) %	49.5
B	Calorific Value	
	Low Calorific value (kj/kg)	22415
C	Ultimate Analysis	

Coal Specification of check coal		
		Average Quality
i	C (a.r) %	60.00
ii	H (a.r) %	3.075
iii	N (a.r) %	2.51
iv	O (a.r) %	5.975
v	S.t (a.r) %	0.90
vi	Cl (a.r) %	0.025
vii	F (a.r) %	0.015
D	Ash analysis (% of Wt -dry basis)	
i	Silica(as Sio2)	55.5
ii	Alumina(as Al2O3)	27.7
iii	Iron oxide(as Fe2O3)	3.3
iv	Titanium oxide(as TiO2)	1.6
v	Phosphorus oxide(as P2O5)	1.3
vi	Sulphur oxide(as SO3)	3.7
vii	Calcium oxide(as CaO)	4.8
viii	Magnesium oxide(as MgO)	1.3
ix	Sodium oxide(as Na2O)	0.3
x	Potassium oxide(as K2O)	0.5
xi	others	-
E	Ash fusibility characteristic	
i	Initial deformation temperature (deg C)	1154
ii	Softening temperature (deg C)	-
iii	Fluid temperature (deg C)	1450
F	Hardgrove grindability index (HGI)	55

1.5.3 Blending coal 1 (only for FGD system land reserving)

The blending coal 1 analysis is assumed as follows:

Coal Specification of blending coal 1		
		Average Quality
A	Proximate Analysis	
i	Moisture (a.r) %	11.2
ii	Ash (a.r) %	19
iii	Volatile Matter (a.r) %	26
iv	Fixed Carbon (a.r) %	43.8
B	Calorific Value	

Coal Specification of blending coal 1		
		Average Quality
	Low Calorific value (kj/kg)	22213
C	Ultimate Analysis	
i	C (a.r) %	58.36
ii	H (a.r) %	3.19
iii	N (a.r) %	2.108
iv	O (a.r) %	5.64
v	S.t (a.r) %	2.63
vi	Cl (a.r) %	0.02
vii	F (a.r) %	0.015
D	Ash analysis (% of Wt -dry basis)	
i	Silica(as Sio2)	55.5
ii	Alumina(as Al2O3)	27.7
iii	Iron oxide(as Fe2O3)	3.3
iv	Titanium oxide(as TiO2)	1.6
v	Phosphorus oxide(as P2O5)	1.3
vi	Sulphur oxide(as SO3)	3.7
vii	Calcium oxide(as CaO)	4.8
viii	Magnesium oxide(as MgO)	1.3
ix	Sodium oxide(as Na2O)	0.3
x	Potassium oxide(as K2O)	0.5
xi	others	-
E	Ash fusibility characteristic	
i	Initial deformation temperature (deg C)	1154
ii	Softening temperature (deg C)	-
iii	Fluid temperature (deg C)	1450
F	Hardgrove grindability index (HGI)	55

1.5.4 Blending coal 2 (only for ESP reserving)

The blending coal 2 analysis is assumed as follows:

Coal Specification of blending coal 2		
		Average Quality
A	Proximate Analysis	
i	Moisture (a.r) %	3.5
ii	Ash (a.r) %	38.5
iii	Volatile Matter (a.r) %	30

Coal Specification of blending coal 2		
		Average Quality
iv	Fixed Carbon (a.r) %	28
B	Calorific Value	
	Low Calorific value (kj/kg)	22644
C	Ultimate Analysis	
i	C (a.r) %	56.3
ii	H (a.r) %	4.06
iii	N (a.r) %	2.108
iv	O (a.r) %	5.58
v	S.t (a.r) %	1.52
vi	Cl (a.r) %	0.02
vii	F (a.r) %	0.015
D	Ash analysis (% of Wt -dry basis)	
i	Silica(as Sio2)	55.5
ii	Alumina(as Al2O3)	27.7
iii	Iron oxide(as Fe2O3)	3.3
iv	Titanium oxide(as TiO2)	1.6
v	Phosphorus oxide(as P2O5)	1.3
vi	Sulphur oxide(as SO3)	3.7
vii	Calcium oxide(as CaO)	4.8
viii	Magnesium oxide(as MgO)	1.3
ix	Sodium oxide(as Na2O)	0.3
x	Potassium oxide(as K2O)	0.5
xi	others	-
E	Ash fusibility characteristic	
i	Initial deformation temperature (deg C)	1154
ii	Softening temperature (deg C)	-
iii	Fluid temperature (deg C)	1450
F	Hardgrove grindability index (HGI)	55

1.6 Fuel Oil

HSD (Light fuel oil) will be used for igniting and fire stabilizing of boiler, the characteristics provided by owner as listed below.

HSD Specification

Test	Test Method	Specification Limit
Specific gravity 60/60°F	ASTM D 1298	Max. 0.870
Distillation 90% recovery, °C (°F)	ASTM D 86	Max. 363(685)
Colour ASTM	ASTM D 1500	Max. 2
Flash point (PMCC), °C(°F)	ASTM D 93	Min. 54(130)
Sulphur content, % wt.	ASTM D 1551/1266	Max. 1.0
Copper strip corrosion 3 hrs. at 50°C (122°F)	ASTM D 130	Max. 1
Viscosity Kinematic 37.8°C (100°F) cst	ASTM D 445	Min. 1.0 Max.
Cloud point, °C (°F)	ASTM D 97	Max. 6(43)
Pour point, °C (°F)	ASTM D 97	Max. 3(37)
Conradson carbon residue on 10% distillation residue, % wt.	ASTM D 189	Max. 0.2
Ash, % wt.	ASTM D 482	Max. 0.01
Sediment, % wt.	ASTM D 473	Max. 0.01
Water, % Vol.	ASTM D 95	Max. 0.05
Cetane number or Centane index	ASTM D 613 ASTM	Min. 45
Strong acid number mg KOH/g	ASTM D 3242	Nil.
Total acid number mg KOH/g	ASTM D 3242	Max. 0.5
Calorific value BTU/Lb.	ASTM D 240	Min. 19000

1.7 Water Analysis

In the project, the water source is the raw water. The raw water analysis of designing will be as follows:

Raw Water Analysis

Test	Unit	Well Water	Canal Water
pH	-	8.02	7.49
Conductivity	μs/cm	571	257
Total Suspended Solids	ppm	-	434
Calcium Hardness	ppm	85	64
Magnessium Hardness	ppm	61	36
Total Hardness	ppm	146	100

Total Alkalinity	ppm	127	100
Sulfate	ppm	79	21
Chlorides	ppm	24	24
Iron	ppm	0.08	0.7

1.8 Environmental and Guidelines of the Area

1.8.1 Flue Gas Emissions

According to the owner and the provisions of the tender documents, the emission standards as follow:

Item	Flue Gas Emission Limits
PM	500 mg/Nm^3 for design coal in 1.5.1 / 100 mg/Nm^3 for Blending coal 2 in 1.5.4
SO_2	No garantie
NO_x	Less than 510mg/Nm^3 at BMCR for design coal in 1.5.1

1.8.2 Water Discharges

All effluent will be treated so that it is compliant to NEQS effluent disposal standards.

1.8.3 Noise Level

Project noise levels shall meet the limits in the table below. The project shall also not raise the background noise level at the nearest receptor more than 3 dBA maximum.

Time	At industrial and commercial Property
Daytime	75
Nighttime	65

SECTION 2 SCOPE OF WORK AND TERMINAL POINTS

The scope of the EPC Contractor will comprise all specified within Owner's Technical Specification, for design, engineering, procurement, manufacture, packing, loading, forwarding, transport and delivery to site including unloading from carriers at site, handling and storage at site, intra site transport, erection/installation, painting, testing, commissioning, carrying out performance and guarantee tests at site of the systems / equipment inclusive of all Mechanical, Electrical, Instrumentation & Control systems, Civil, Structural and Architectural works on EPC basis. The renewal, demolition work, disassembly & removal and relocation are not included in EPC scope.

The EPC Contractor will deliver all necessary functionalities and works including dismantling, adaptations & refurbishment of existing and conserved systems for a Power Plant that of two units 365 MWe with pulverised coal-fired boiler.

Because of lacking the data of the domestic coal, all of the Options mentioned in the Technical Specification will be considered in the future by Owner. But the land will be reserved for the FGD in the plan layout and, ESP performance can be increased in the future extension.

The mainly terminal points will be:

No.	Battery limits at:	Contractor	Note
1	turbine MS stop valve inlet	MS piping and its hanger and support from the new boiler to the turbine MS stop valve inlet shall be in SEC's scope.	Connecting pipes with existing Name: MS piping Diameter: ID260.35 Thickness: 26.035 Material: A335P91
2	turbine HP cylinder exhaust steam outlet	CRH piping and its hanger and support from the new boiler to the turbine HP cylinder exhaust steam outlet shall be in SEC's scope.	Connecting pipes with existing Name: CRH piping Diameter: OD 558.8 Thickness: 12.7 Material: A672B70CL32
3	turbine HRH stop valve inlet	HRH piping and its hanger and support from the new boiler to the turbine HRH stop valve inlet shall be in SEC's scope.	Connecting pipes with existing Name: HRH piping Diameter: ID533.4 Thickness: 26.035

			Material: A335P22
4	1m away outside turbine house DA bay at boiler front area.	HPFW piping and its hanger and support from the new boiler to the confluence tee outlet downstream HP heater 8 shall be in SEC's scope.	Connecting pipes with existing Name: HPFW piping Diameter: OD 355.6 Thickness: 26.035 Material: 15NiCuMoNb5-6-4
5	1m away outside turbine house DA bay at boiler front area for heavy oil steam atomization after the attemperator outlet	The new HSD atomization steam piping and its hanger and support from the terminal point to the new boiler shall be in SEC's scope. The detail shall be discussed during detail design stage.	Connecting pipes with existing Name: Later Diameter: Later Thickness: Later Material: steel 20
6	1m away outside fuel oil pump house for HSD supply and return piping	The new HSD piping and its hanger and support from the terminal point to the new boiler shall be in SEC's scope. The detail shall be discussed during detail design stage.	Connecting pipes with existing Name: Later Diameter: Later Thickness: Later Material: steel 20
7	1m away outside turbine house DA bay at boiler front area for boiler area auxiliary steam piping	The new boiler area auxiliary steam piping and its hanger and Name: support from the terminal point to the new boiler shall be in SEC's scope. The detail shall be discussed during detail design stage.	Connecting pipes with existing Later Diameter: Later Thickness: Later Material. steel 20
8	1m away outside turbine house DA bay at boiler front area for boiler CBD piping	The new boiler CBD piping and its hanger and support from the terminal point to the new boiler shall be in SEC's scope. The detail shall be discussed during detail design stage.	Connecting pipes with existing Name: Later Diameter: Later Thickness: Later Material: steel 20
9	1m away outside turbine house DA bay at boiler front area for boiler filling water piping	The new boiler filling water piping and its hanger and support from Name: the terminal point to the new boiler shall be in SEC's scope. The detail shall be discussed during detail design stage.	Connecting pipes with existing Later Diameter: Later Thickness: Later Material: steel 20
10	Turbine HP bypass valve inlet and outlet and condenser inlet	The turbine HP bypass steam piping shall be replaced except HP Bypass bypass valve and its auxiliaries. The new turbine HP bypass steam piping between the terminal point and its hanger and suppon shall be in SEC's scope. The detail shall be discussed during detail design stage.	Connecting pipes with existing valve inlet Name: Later Diameter: Later Thickness: Later Material: A335P91 Bypass valve outlet Name: Later Diameter: Later Thickness: Later

			Material: 12Cr1MoVG/steel 20
11	Coal Handling System	Starts at the wagon tripper room (including the coal unloading device), but rail line inside Site (including needed information"s facilities for train operator)are not in the EPC contractor scope.	
12	IPBD branch	Starts with the existing generator outlet IPBD	
13	Auxiliary cooling water	Starts from existing CW inlet pipe	Connecting pipes with existing Name: CW pipe Diameter:DN350mm Thickness:8mm Material: carbon steel Q235A
14	Potable water	Starts from existing potable water main	Connecting pipes with existing Name: potable water network Diameter:100mm Thickness:4mm Material: carbon steel Q235A
15	Reclaimed water	Starts from existing CW water pipe	Connecting pipes with existing Name: CW pipe Diameter:DN150mm Thickness:4.5mm Material: carbon steel Q235A
16	Rain water	Finishes at 1meter from site boundary	
17	Fire water	Start from existing raw water network	Connecting pipes with existing Name: Raw water network Diameter:DN150mm Thickness:4.5mm Material: carbun steel Q235A
18	The DM. water pipe	Post-DM water treatment plant	Connecting pipes with existing Name: the DM. Water pipe Diameter:DN150 Thickness:4.5mm

			Material: stainless steel
19	The Acid pipe	Post-DM water treatment plant	Connecting pipes with existing Name: the Acid pipe Diameter:DN40 Thickness:2.5mm Material: rubber lined steel
20	The Alkali pipe	Post-DM water treatment plant	Connecting pipes with existing Name: the Alkali pipe Diameter:DN40 Thickness:2.5mm Material: steel
21	The Wastewater pipe	Post-DM water treatment plant	Connecting pipes with existing Name: the wastewater pipe Diameter:DN50 Thickness:3.5mm Material: rubber lined steel
22	Access road	Road for the new boiler area within the plant.	

SECTION 3 GENERAL LAYOUT

3.1 Plant General layout

New boiler Unit 1&2 is located at the position of the existing heavy fuel oil storage tank 3&4. According to Technical Specification, the coal will be transported to site through railway. Railways lines shall be erected on specific dam insuring protection of power plant against floods and allowing rail lines level over foods level. Consequently train unloading station will be located on east side of power plant. And circular Coal storage yard is located on north of power plant.

Fly ash silo, sanitary sewage treatment plant, fire water pump house are arranged at north of new boiler .Ash pond is located at northwest of power plant.

The plant general layout refers to attached drawing No. AF439K-Z01 "Plot Plan".

The Plant Layout will be jointly assessed and finalized in future and the final layout shall be subject to confirmation by the Owner.

3.2 Plant Vertical Layout

According to Technical Specification, the elevation of the existing Power station is approximately 117 to 122 m above mean sea level (MSL), so the site elevation is designed as the same as the existing power station. The height difference between inside floor and outside ground of building is 0.3m generally.

The detailed site vertical design will be confirmed when the more relevant information will be obtained at next stage.

3.3 Plant Internal Roads

Adequate road and square will be arranged for the plant, surface of road shall be constructed with concrete. The width of the main road is 7.0m and other road is 4.0m. The main road turning radius is 9.0m and other road turning radius is 6.0m.

3.4 Piping and Trench

Outdoor cable and most of pressure pipes shall be laid overhead.

Some pipes with gravity flowing liquid such as sewage pipe, rainwater pipe shall be arranged underground.

Where the pipe rack passes over the roads or squares, the minimum net overhead height of 5m shall be maintained.

SECTION 4 MECHANICAL SYSTEM

4.1 Boiler & Auxiliaries

4.1.1 Boiler

The boiler is supplied by Shanghai Boiler works, Ltd. (SBWL) in China and it shall be of 300MW class natural circulation, sub-critical pressure with single steam drum and single reheat. It is semi-outdoor arranged and has a single furnace of reverse u-form (-type, Double pass) arrangement and full pendant steel structure, dry bottom type water-cooled, balanced draft furnace and is designed with tangential firing arrangement of burners. There are five mills with 20 coal nozzles in different elevation in the furnace zone of the boiler. Light diesel oil will be used for start-up and stable combustion. The light diesel oil will be designed for 15 % BMCR load and steam atomization. The boiler will be designed to achieve a stable flame without oil burner support down to a load of 40% BMCR and will be designed to achieve stable unit operation down to 40% TMCR with any two adjacent mills in operation.

All the designs will be in accordance with ASME "boiler and pressure vessel code" and "National fire protection association code".

Boiler capacity and main parameters as follows:

Boiler Capacity	MW	365
	Unit	BMCR
Maximum Steam Flow	t/h	1200
Superheat Steam Outlet Temperature	°C	544
Superheat Steam Outlet Pressure	MPa(g)	17.9
Reheat Steam Flow	t/h	1197.9
Reheat Steam inlet Temperature	°C	332
Reheat Steam inlet Pressure	MPa(g)	3.80
Reheat Steam Outlet Temperature	°C	544
Reheat Steam Outlet Pressure	MPa(g)	3.58

4.1.2 Pulverized Coal System

The coal pulverization and firing system design will ensure complete safety of the plant, equipment and the personnel.

4.1.2.1 Coal Chutes and Bunker Shut Off Valves

Raw coal chutes and bunker shut off valves will follow as below:

(a) Motor operated Raw Coal Bunker shut off gate at the bunker outlet and manual gate at RC feeder inlet. All components of gates coming in contact with coal will be of stainless steel.

(b) Coal connecting pipe between bunker shut off gate and RC feeder inlet will be φ920 mm(holding).

(c) Coal connecting pipe between outlet of feeder and inlet of mill along with motor operated shutoff gate at RC feeder outlet.

4.1.2.2 Pulverizer

Direct firing, pressurized cold primary air, pulverized coal system with MSM will be adopted in this project. Five (5) sets of MSMs, electric gravimetric coal feeders (EGCF) and raw coal bunkers will be provided for each boiler.

Raw coal from raw coal bunker via EGCF will be pulverized and dried in the MSM, then be separated in the MSM separator. There are four (4) pulverized coal pipes on each separator connected to four corners of boiler burners in the same level. Five (5) sets of MSMs correspond to five (5) level burners of each boiler. Diameter adjustable device will be placed at pulverized coal pipes, so that the resistance of each pipe is the same.

Mill steam inerting system will be provided as per standard and proven practice of manufacturer. Suitable lifting device for mill maintenance will be provided.

Each MSM will be equipped with one gravimetric type coal feeder. Coal feeder can endure the exploding pressure of 0.35MPa. The EGCFs have alarms of coal flow break and block, EGCF equipped with coal flow monitor etc, so that operator can handle emergency and ensures safe operation.

Each pulverizer will be complete with all wear parts, grinding elements, lubrication system (consisting of 1 x 100% lube oil pump, 1 x 100% lube oil coolers, 1 x 100% filters etc), drive motor, auxiliary gear, and with platform around pulverizer for safe and efficient operation of pulverizer.

4.1.2.3 Pulverized Fuel Piping

a) The design and arrangement of fuel pipe will ensure uniform distribution of primary air and pulverized coal between all burners served by one pulveriser under all conditions of loading.

b) Coal air mixture velocity in coal pipes - minimum - 15 m/sec and maximum - 28 m/sec.

c) The piping system shall be designed for a continuous operating temperature of 90 degree Celsius (minimum).

d) Metal expansion joints for PF piping shall be provided to take up the furnace expansion.

e) Shut off manual gate valve before each coal burner and a power operated mill discharge gate valve at each classifier outlet on each pulverized fuel pipe.

f) Suitable devices shall be provided in each pulverized coal pipes to enable on load adjustment for equalizing flow.

4.1.3 Air and Flue Gas System

Direct firing. pressurized cold primary air system with MSM shall be adopted in the project. Each boiler will be equipped with 2 sets of axial type, constant speed variable pitch controlled FD fans, 2 sets of axial type. Constant speed, blade pitch controlled ID fans, 2 sets of axial, constant speed, variable pitch PA fans and two (2) sealing air fans. During operation, pressurized air shall be forced into furnace. Flue gas from the furnace shall be induced to atmosphere via chimney.

4.1.3.1 Primary air system

Main function of the system is to feed pulverized coal. A part of cold air from PAFs shall be forced into trisector regenerative air preheater. After being heated, this part of primary hot air shall be lead to MSMs. The rest part of cold air from PAFs shall be lead to primary hot air duct for temperature adjustment. The mixed primary hot and cold air will be lead to MSMs, and it will be acted as dry medium. Cold primary air to MSMs (boosted by sealing air fan) and EGCFs will be acted as seal medium. The axial, constant speed, variable pitch PA fan can adjust air flow and pressure automatically.

Primary air will be heated in air preheater, and be sent to MSMs via common manifold. Primary air damper will be placed at air preheater outlet. When air preheater failure happen, the damper will be closed.

Pressurized cold air from PAFs will be regarded as regulating temperature for MSMs and sealing air for EGCFs. Some of primary cold air will be sealing air for MSMs via sealing air fan. The former will be mixed with hot primary air. Mixed air can meet the temperature requirement of coal dried in the MSM and lead pulverized coal out of MSM to burner.

When one MSM failure happens and shuts down, the corresponding pneumatic damper on primary hot air duct shall be closed immediately to avoid primary hot air enter into MSM. To avoid primary hot air enter into the duct of primary cold air, motorized damper on the cold duct will be also closed immediately. Air flow measurer will be installed on the air duct.

PA Fan Characteristics

PA fan shall be centrifugal type.. PA fan shall be compatible with Pulverized Fuel system resistance and boiler operation at rated loads, during boiler start up & low load operation condition.

The system resistance curves shall always be sufficiently below the fan stall line.

The margins shall be 20% for flow & 25% for head, and the margins shall be respectively over the calculated values at 100%BMCR condition (based on design coal) in the project.

PAF Suction:

a) Silencers shall be provided at the suction of PA fans to limit the noise level as specified.

b) PA fan suction shall be provided with trash screen assembly and shall have suitable arrangement to avoid rainwater from directly entering the fan.

c) Location of PA fan suction hood shall prevent entry of dusty air into fan

4.1.3.2 Forced Draft and Induced Draft System

The system shall provide air for furnace combusting by FDFs and induce flue gas for keeping furnace balance by IDFs. Cold air from FDFs shall be forced into trisector regenerative air preheater (APH), and hot air will be sent into secondary air box and be distributed to furnace for combusting. Flue gas induced by IDFs shall be exhausted to atmosphere via chimney.

Two (2) FDFs will be equipped for each boiler. Cold air interconnecting duct, which connect two ducts between FDFs downstream will be set, and hot air liaison duct arranged at APH outlet. Hot secondary air (SA) box is special design, control damper and flow measurement device have been equipped for hot SA duct, hot SA flow to the boiler will be almost equal, so that stable combusting and reasonable temperature field in the furnace can be ensured, and will reduce temperature deviation at two sides of boiler.

Motor operated damper will be equipped on hot SA duct at APH outlet. When APH is out of operation, the damper shall be closed automatically. Damper and air flow measuring instrument shall be equipped for each branch of hot SA duct, the details refer to air & gas system drawing.

Two (2) IDFs will be equipped for each boiler,flue gas heat primary cold air and secondary cold air by APH. Then flue gas will through ESP and draught to chimney by IDF. Motorized dampers will be equipped for the inlet gas duct of APH. when APH is out of operation, the corresponding dampers shall be closed automatically.

Two trisector regenerative air preheater will be equipped, and primary and secondary air will be heated in it. Detail of APH will be submitted by SBWL within the design basis report of boiler.

The forced draft (F.D.) and induced draft (I.D.) fans shall be capable maintaining balance draft conditions in the furnace over the entire load range while firing the specified range of fuels.

For FDF and IDF design, the margin shall be 10% for flow & 20% for head. And the margins shall be respectively over the calculated values at 100%BMCR condition (based on design coal) in the project.

ID fan component shall also be designed to withstand a certain extent excursions in flue gas temperature, keep the safe and smooth operation of fans and without any damage or increased maintenance.

FD and ID fans shall meet following operational requirements.

Mode of operation: Two fan in parallel

The fans shall be suitable for parallel operation and sharing the load capacity over the entire range of operation without hunting. Pulsation shall be avoided by suitable design of fans and connected ductwork.

The layout of FD and ID fans shall ensure interchangeability of the impellers.

FDF Suction:

a) Sileocers shall be provided at the suction of FD fans to limit the noise level as specified.

b) FD fan suction shall be provided with trash screen assembly and shall have suitable arrangement to avoid rainwater from directly entering the fan.

c) Location of FD fan suction hood shall prevent entry of dusty air into fan.

4.1.3.3 Sealing air system

2x100% centrifugal sealing air fans will be equipped in the system, one in operation and another standby. A part of primary air will be boosted by sealing air fan, and then it will be sent into MSMs as sealing air. At sealing air fans inlet, air filters and motorized dampers will be arranged, and at sealing air fan outlet; the automatic divert discharge damper will be arranged. when one fan is in operation, another's inlet damper is closed.

4.1.3.4 Electrostatic Precipitator (ESP)

One boiler will be equipped with two sets of ESPs. Flue gas from economizer will enter into two (2) air preheaters, one motor operated damper will set at the inlet of each air preheater gas side.

When emergency happens to one air preheater, the respective damper will be closed. During air preheater start up or shut down, the damper will be opened or closed.

Flue gas from air preheater enters into ESP with four electric-fields. Flue gas via ESP, IDF & chimney will be vented into atmosphere. One motor operated damper will be placed at ESP outlet connecting duct.

Motor operated dampers will be placed at IDF inlet & outlet. When IDF failure happens, it will be overhauled after the dampers closed. During IDF starting up or shutting down, the dampers will be opened or closed.

The inlet of the precipitators shall be provided with suitable flanged connections with the flue gas ducting which shall be completely seal welded inside and outside after assembly.

The dust concentration at the outlet of Electrostatic Precipitator shall be limited as follows: ≤500 mg/Nm^3 with one field out of service at 100%BMCR operation when design coal fired; ≤100 mg/Nm^3 with all field in service at 100%BMCR operation when design, check and blending coal fired.

4.1.3.5 Duct and Dampers

Various type of dampers as shown in system diagram. And the dampers will be provided at various location as shown in system diagram. Design and constructional features of dampers will be as per further contract.

Thickness of air duct will be 4 mm and thickness of flue gas duct will be 5 mm. Material of construction of ducts will be carbon steel. These ducts will meet design and constructional requirement as per contract. Considering low load operation condition, the gas flow will be less and gas velocity will be low, so ash loading in gas duct at upstream and downstream of ESP will be considered.

4.1.4 Fuel oil System

Fuel oil system being provided will cater to high speed diesel (HSD) firing requirements of

Steam Generators. The HSD shall be used for cold start-up, warm-up purposes, start-up / commissioning activities, for fire stabilizing and firing up to 15% BMCR of the main boilers.
For this renovation project, if the original HSD system has enough capacity to supply the oil for one boiler igniting plus one boiler stabilizing, the original HSD supply and storage system and equipment can be reserved for the new boilers.
According to the information received, the HSD supply and return oil system shall be connected from the plant HSD oil piping of the existing power plant.

4.2 Steam Turbine & Auxiliaries

For this renovation project, the steam turbine and its auxiliaries shall be kept same, and only part of system will be modified to match with the new boiler-turbine system operation, such as main steam and reheat steam system, feed water system and auxiliary cooling water system etc.
The following description is main system modification.

4.2.1 Main steam and reheat steam system

Main steam system will convey superheated steam from the super-heater outlet to the HP main steam valve.
Reheat steam system will convey cold-reheat steam from HP casing exhaust spout to inlet of boiler reheater and convey hot-reheat steam to IP main steam valve.
Main steam and reheat steam is a unit system.
The new renovation main steam piping and reheat steam piping shall be connected from the original turbine steam inlet and outlet via piping rack to new boiler.
To make sure that the original M-BFP can be reserved and the new boiler motive steam parameter can reach the requirement of turbine at 100%BMCR and 100%TMCR condition, the preliminary hydraulic calculation has been done, and the diameter of MS system piping has been enlarged; And to try to reduce the RH system pressure drop, the diameter of RH system piping has been enlarged too, and the pressure drop is about 20% of turbine HP cylinder exhaust steam

Piping material shall be as following:

Main steam piping: A335P91
Cold reheat steam piping: A672B70CL32
Hot reheat steam piping: A335P22

4.2.2 Feed-water system

The function of this system is to pump feed-water from deaerator storage tank to economizer inlet header of boiler through three HP heaters via motor-driven feed water pumps with hydraulic couplers. Feed water is heated to the given temperature in HP-heaters by turbine extraction steam to improve heat efficiency of the unit.

The new renovation HP feed water piping shall be connected from the existing piping at 1m away out of DA bay via piping rack to new boiler.

Piping material shall be as following:

HP feed water piping: 15NiCuMoNb5-6-4.

4.2.3 Auxiliary cooling water system

Considering new boiler auxiliaries, more cooling water will be required than fuel oil boiler auxiliaries, so auxiliary cooling water system capacity should be increased.

For this project, an additional auxiliary cooling water system will be set for new boiler auxiliaries each unit. Each system shall be with two 100% ACW transfer pumps and one 100% filter.

Piping material shall be as following:

ACW water piping: Steel 20

4.3 Coal Handling System

4.3.3.1 Coal Unloading system

The imported coal will be delivered by trains. The coal will be unloaded from wagons by wagon tripper, and then it will be transferred to circular coal storage yard through conveyor belt. The local coal will be delivered by trucks, but in current design the truck unloading area and interface are reserved.

Two set of wagon trippers will be arranged for coal unloading from wagons. In general, one set of wagon tripper will be in operation and the other will be in standby. However, two set of wagon trippers will be able to operate simultaneously.

Under the each wagon tripper, coal hopper is arranged. Under the each coal hopper, two coal feeders with feeding capacity of 750t/h are installed.

4.3.3.2 Coal Yard and Storage Facilities

Three circular coal storage yards will be arranged in the plant. Two circular coal storage yards with 120m diameter are used for imported coal storage; the storage capacity of them is 2x150000t. One circular storage yard with 100m diameter is used for imported coal during few first year of power plant operation, but as the development of domestic mine, it will be particularly used for local coal storage; the storage capacity of this circular coal storage yard is 1x100000t. The total storage of the three circular coal storage yards is 40×10^4t, which is enough for about 60 days coal consumption for full load of two boilers.

Three set of stacker-reclaimers with stacking capacity of 1500 t/h and reclaiming capacity of 600t/h will be installed in each circular coal storage yard. All controls required for the stacking and reclaiming operations will be installed in the operator cab. All drives will be designed for continuously operation.

Coal hopper and emergency coal hopper are arranged for each circular coal storage yard. Under the coal hopper and emergency coal hopper, coal feeder with feeding capacity of 600t/h is installed.

Three bulldozers and one wheel type loaders will be furnished for auxiliary working.

4.3.3.3 Belt Conveyor System

Double stream belt conveyor system will be arranged. Before the circular coal storage yard, the belt conveyors will be designed with B=1400mm, v=2.5m/s, Q=1500t/h. After the circular coal storage yard, the belt conveyors will be designed with B=1000mm, v=2.0m/s, Q=600t/h. Fire-resistance belt will be used for all conveyors.

NO.7, NO.8 and NO.9 belt conveyor will be single.

In general, one of the double belt conveyors will be in operation and the other will be in standby. However, the two belt conveyors will be able to operate simultaneously.

Electric two-side ploughs will be installed on NO.14 A/B/C belt conveyor in coal bunker bay for unloading coal to coal bunkers.

Closed galleries will be arranged for all the belt conveyors.

4.3.3.4 Coal Crushing System

The in-plant coal size is less than 50mm; the crushing system will meet the need of the boilers to coal size.

The coal crusher house is located behind the coal yard. There is a hoisting device and enough space in the coal crusher house for maintenance.

Two set of crushers with capacity of 600t/h will be installed. The max inlet size of the crusher is 300mm. The size of the crushed coal will be within 30mm.

4.3.3.5 Control of Internal Coal Handling System

Individual DCS subsystem and local control mode will be adopted in the coal handling system. The stacker-reclaimer will be controlled locally.

The control of the coal handling system will be performed in the control room, which shall be located in the middle of the conveying system.

Operating modes of the coal handling system can be selected and switched in the control room.

Local push-button can be used for emergency shut down. Interlock and protecting devices are installed for the whole coal handling system.

The control system of conveyors will have sensors including zero speed switch, belt sway switch, pull cord switch, plugged chute switch and stick ability trembler, high/low bin level signal, radar level signal, etc. A sound alarm will be automatically actuated by the switching-on of any equipment.

4.3.3.6 Auxiliary Facilities of Coal Handling System

Two-stage magnetic separator will be installed before coal crushers to remove tramp iron in the coal. And one-stage magnetic separator will be installed after coal crushers.

Mechanical sampling devices, belt scales and coal deposit pond will be designed in Coal Handling System.

4.4 Ash Handling System

4.4.1 Main Design Principle

Ash handling system will include bottom ash,fly ash handling system and mill rejection handling system. The wet type system will be adopted for bottom ash handling, pneumatic pressure conveying system for fly ash handling and mechanical system for mill rejection handling.

4.4.2 Ash quantity

		Quantity per hour(t/h)				Quantity per year ($1x10^4$t/h)			
		Fly ash	Bottom ash	Mill rejection	Sum	Fly ash	Bottom ash	Mill rejection	Sum
1X365MW	Design coal	17.56	1.95	0.67	20.18	11.41	1.27	0.44	13.12

	Check coal	21.76	2.42	0.75	24.93	14.14	1.57	0.49	16.20
2X365MW	Design coal	35.12	3.9	1.34	40.36	22.82	2.54	0.88	26.24
	Check coal	43.52	4.84	1.5	49.86	28.28	3.14	0.98	32.4

4.4.3 Bottom ash handling system

The scope of bottom ash handling system is from bottom ash discharging outlets of the 2 boilers to bottom ash storage area's exits.

The purpose of bottom ash handling system is to remove bottom ash from bottom of the boiler to bottom ash storage area. There are two types of bottom ash handling system in general, one is dry type system and the other is wet type. Because the dry type system has a negative influence on the boiler efficiency according to the operating experience and data of power plant, and can cause the increase of coal consumption. In addition, the dry bottom ash can also cause a high level of environmental contamination in the ash storage area. The wet type system will be recommended for this project. For details please see drawing 50-AF439K-C01 "Bottom Ash Handling System Diagram ".

The continuous bottom ash produced by the boiler shall be removed from beneath the furnace by means of a submerged scraper conveyer, then fails into bottom ash storage area directly. In the system the bottom ash is cooled by water. The system could remove a 6 hours backlog of bottom ash with each unit at 100% BMCR.

One submerged scraper conveyer which the capacity is 5-12t/h will be equipped for each boiler. Each unit is equipped with one bottom ash storage area, the capacity of which can retain more than 72 hours' bottom ash. The bottom ash after draining will be transport to ash pond by ash trucks.

The overflow water from each submerged scraper conveyer and bottom ash storage area will fall into a below ground gravity sluiceway to flow into drain sump which is located beside the conveyer for each boiler, then feed back into submerged scraper conveyer or coal deposit pond by drain pumps, and the slag will be send back too, but there is not overflow water when the bottom ash system operates properly.

4.4.4 Fly ash handling system

The scope of fly ash handling system is from outlets of ESP, APH, and ECO. hoppers' outlets to fly ash buffer silo's outlets including the discharging equipments.

Positive dense pneumatic conveying system will be adopted for fly ash handling. For details please see drawing 50-AF439K-C02 "Fly Ash Handling System Diagram".

The fly ash discharged by ESP, APH and ECO, the capacity is about 27t/h, which is 1.5 times of each boiler's design fly ash quantity at BMCR condition. There are 32 ESP hoppers, 8 APH hoppers, and 4 ECO hoppers for each boiler. And for each boiler, there are totally four ash pipes, one pipe for the APH and ECO hoppers, three pipes for the ESP hoppers. Fly ash from each hopper will fall into a transmitter through inlet valve, being conveyed afterward to fly ash silos by compressed air.

A fluidizing air system including two fluidizing blowers and air electric heaters is devised for each boiler's hoppers, one in operation and one standby. It will be designed to make the ash discharge smoothly from the hoppers.

There are three ash silos for this project and the usable volume of each is 5400m^3, which can storage 12000t fly ash totally. The fly ash of the ESP, APH and ECO of the 2 boilers will be transported into the silos. One vent filter will be located on each silo's roof for vent air cleaning.

A fluidizing air system including 3 fluidizing blowers and air electric heaters is devised for the three silos. It will be designed to make the ash discharge smoothly from the silos.

There are two outlets under each ash silo. The fly ash can be discharged by dry type for complex utilization or conveyed to ash yard by positive dense pneumatic conveying system. One dry ash unloading spouts will be installed under one outlet of each silo, the capacity of which is 150t/h. The discharged ash will be transported to end users destination by trucks. One transmitter will be installed under the other outlet of each silo, and can convey the unsold ash to ash yard by compressed air.

There are two steel fly ash buffer silos near the ash yard, and the usable volume of each is

200m^3, accepting the fly ash conveyed from fly ash silos to avoid contamination of environment by fly ash. Two twin-Paddle mixer/unloaders equipped under the two outlets for ash conditioning, then the ash will be stored into the ash yard by trucks. A fluidizing air system including 2 fluidizing blowers and air electric heaters is devised for the two silos. It will be designed to make the ash discharge smoothly from them.

The compressed air is supplied for fly ash handling system. The conveying air compressors and air dryers are installed in conveying air compressor house. 3 sets screw air compressors are adopted in the compressed air system for the 2 boilers (2W+1S), the capacity of which will be 42m^3/min, 0.75MPa each. In addition, 3 refrigerated air dryers will be provided to reduce the humidity of the compressed air, hence reduce the possibility of plugging in the ash pipe.

4.4.5 Mill Rejection Handling System (Mechanical) description

A simple mechanical handling system will be used for mill rejection handling. For details please see drawing 50-AF439K-C03 "Mill Rejection Handling System Diagram".

In each shift, mill rejection discharged from each mill will be hold in a movable hopper for a period until a fork lift come to move the hopper out of bunker bay. The movable hopper will then be lifted to make mill rejection discharge into a truck for further transportation to ash yard for depositing.

There is flushing water in the mill reject case for cooling mill rejection and preventing the dust.

5.2.3 System Description

Because the material of CW pipe is unknown, the carbon steel will be assumed to be the material of constructed CW pipe and the cooling water for boiler auxiliary is to be taken from constructed CW inlet pipe of power plant.

The nominal diameter of main auxiliary cooling water pipe is DN350 and DN250 or DN150 for branch pipe. For detail of the ACW system, please refer to 50-AF439K-S01, *Principle Diagram of Water Supply System*.

5.3 Plant Water Supply System

5.3.1 System function

The plant water supply system will supply water to users in boiler area and part of plant area. The system includes potable water system and reclaimed water system.

5.3.2 Scope

A set of water supply system for new part of power plant will be designed and provided.

5.3.3 System description

(1)Potable water supply system

The potable water will be taken from the existing potable water pipe in power plant. The nominal diameter of main pipe will be DN100.

(2) Fire water system

New fire water boosting system and fire water pipeline network will be provided for new boiler and coal handling system. One set of electric motor-driven fire pump, one set of diesel engine fire pump and two sets of jockey pump will be provide.

1000m^3 fire water tank will be provided for fire water storage.

(3) Reclaimed water system

The waste water generated in the process of operation shall be collected to waste water treatment system, after being treated to meet the requirement of reclaimed water. It can be reused as the water source of the coal yard sprinking water, washing water for coal handling system and ash handling system. The reclaimed water system consists of reclaimed water reservoir, reclaimed water pumps and reclaimed water pipelines.

The make-up of reclaimed water will be taken from existing CW pipe.

5.4 Plant drainage system

5.4.1 System function

The plant water drainage system collects the drainage water in new part of plant area. The system includes sanitary sewage water system, industrial waste water (The water has been treated to meet the requirement of the drainage standard), and rain water drainage system.

5.4.2 Scope

A complete water drainage system for new construction part of power plant will be designed and provided.

5.4.3 System description.

The separate waste water collection and drainage systems composed of sanitary sewage system, rainwater and industrial waste water system, will be adopted to collect the sanitary sewage, rainwater and industrial waste water for new part of power plant.

The sanitary sewage gathered together through a separate drainage pipeline network will be discharged to sanitary sewage treatment plant for treatment to meet the requirements of reclaimed water quality.

For industrial contaminated wastewater, after being treated individually, it will be collected and drainage to the reclaimed water storage reservoir for reusing.

For non-contaminated industrial waste water, it will be collected and directly drainage to the reclaimed water reservoir.

For the rain water of new part of power plant, it can be collected and discharged to rain water storage basin and used for ash/residue mixture.

5.4.4 Coal contaminated waste water and sanitary sewage treatment plant

5.4.4.1 Coal contaminated waste water treatment plant

The coal contaminated waste water treatment plant will treat the plant coal contaminated waste water from coal handling system and coal yard. The coal contaminated water after being treated will be reused.

The scope of the system includes complete coal contaminated water treatment plant including boosting pump, treatment equipment, pipes, valves etc.

The preliminary treatment capacity is $2\times20m^3/h$.

5.4.4.2 Sanitary sewage treatment plant

A new sanitary sewage treatment plant is to be built for new part of power plant. The sanitary sewage treatment plant will treat the plant sanitary sewage for the purpose of reusing.

A sanitary wastewater treatment plant will be designed and provied.

The preliminary treatment capacity is $2\times2m^3/h$.

SECTION 6 CHEMICAL WATER TREATMENT

6.1 DM water polishing treatment System

6.1.1 Design condition

The conductivity of existing DM water is 2~6μm/cm.

The DM water polishing treatment System will be designed according to the condition:

The acid & alkali system and wastewater treatment system had be designed in the existing DM. water system

6.1.2 System description

In order to improve the existing DM. water quality, DM water polishing system will be provided to get the DM water with its quality conforms to the standard required for the new boiler.

1) System flow diagram

The principal flow diagram of water treatment system is as follows:

DM. water from the existing DM. water pump Mixed bed Thermal system of main building.

2) Output of water treatment system

Output of mixed bed system: 2X 65m^3/h

3) Quality of demineralized water

The effluent quality of demineralization system is as follows:

- Conductivity: <0.3μs/cm(25^{0}C)
- Silica dioxide: < 20μg/l

6.1.3 Operating and controlling

The whole post-DM water treatment system shall be operated automatically.

One train of mixed bed will be running and the other one standby.

When unit is in accident or in starting, the two trains" will be put into service.

6.2 Chemical laboratory, analysis instruments and equipment

In the project, chemical laboratory rooms which consist of coal analysis will be arranged in the coal handling control building. Some necessary instruments and equipments will be provided for coal analysis. The water analysis and oil analysis instruments will use the existing system.

6.3 Chemical reagent systems and sampling systems

The existing chemical reagent systems and sampling systems can meet the requirement of the new boilers.

SECTION 7 CIVIL AND CONSTRUCTION

7.1 Architectural Works

7.1.1 Scope

This section covers the detailed technical requirements for the engineering, supply, construction of the Architectural Works, and related facilities.

The scope of work shall mainly include:

- Cladding, roofing, flashing, gutters, downpipes, doors, windows, glazing, ventilation louvers, and other fittings.
- Brickwork, rendering, plastering, tiling and suspended ceilings.
- Painting and surface treatment.

7.1.2 Buildings And Structures

List of Buildings And Structures

No.	Name Of Architectural	Layer Number	Area(m²)	Super Structure	Foundation or substructure
1	Coal Bunker Bay	2	1350	Steel Structure	RC foundation
2	Air Compressors Building	2	432	Steel Structure	RC foundation
3	fly ash silo	2	1524	R.C.C	RC foundation
5	TT-2 Coal Conveying Tower	3	590	Steel Structure	RC foundation
6	TT-3 Coal Conveying Tower	4	576	Steel Structure	RC foundation
7	TT-4 Coal Conveying Tower	8	4576	Steel Structure	RC foundation
9	Lighting Room	1	70	Steel Structure	RC foundation
10	TT-5 Coal Conveying Tower	8	3097	Steel Structure	RC foundation
11	TT-6 Coal Conveying Tower	4	672	Steel Structure	RC foundation
12	TT-7 Coal Conveying Tower	5	1200	Steel Structure	RC foundation
13	Coal Crusher House	4	1246	Steel Structure	RC foundation
18	Coal Handling Control House	1	176	R.C.C	RC foundation
19	Bulldozer Garage	1	153	R.C.C	RC foundation
20	Wagon Tripper Room	1		R.C.C	RC foundation

Note: calculating the area by the dimension of the axes .

7.1.3 Description of Architectural Work

- All buildings are designed to meet the Design Conditions specified in general requirement and in this document.
- Road accesses are provided to all buildings
- Access doors have canopies, and are furnished with leak tightness, weather-proof, insulation, Fire proof doors should provided wherever required. as well as required hardware.
- Handrails with toe plates are provided around openings in floors, platforms and landings. Removable handrails are provided for floor openings as necessary for maintenance operations.
- Roofs are insulated; water proofed & sloped for draining.
- Ferrous material is painted or galvanized
- Monorail hoists or other lifting equipment are provided.
- Reinforced concrete stair treads will be equipped with non-slip nosing.
- All foundations and trenches are of reinforced concrete construction.
- Buildings are architecturally compatible with each other both on elevations and colors.
- The steel stair treads are galvanized gratings. with non-skid metal nosing, fastened with countersunk flat head galvanized mild steel machine bolts with lock washers.
- All gratings are galvanized and fastened with galvanized mild steel studs and nuts and clips in accordance with grating manufacturer''s recommendations
- The Plant Site trenches are reinforced concrete construction.
- Trenches have unimpeded drain. Trenches under roads are strengthened.
- All the material and color of material will be decided later.

7.2 Civil structure

7.2.1 Scope of work

For civil structural parts, the coal bunker building, support structures of flue gas ducts, boiler elevator support structure, coal convey transfer building, chimney and others new buildings/structures for the coal fired plant will be in the scope of SEC.

The critical pipe support will be in the scope of SEC, The TP will be 1.0 meters outside of the main power house

7.2.2 Design code

All the buildings/structures and foundation will be designed as per Chinese GB codes. The equipment foundations will be also designed to match requirements from manufactory.

7.2.3 Load

7.2.3.1 Dead loads

The dead loads includes the self-weight of framing, roofs, floors, walls, partitions, platforms, all permanent equipments and etc.

7.2.3.2 Live loads

Live loads consist of assumed unit loadings deemed sufficient to provide for movable or transitory loads such as people, portable equipment, fixture and etc.

Pipe Hanger Loads and equipment loads

The pipe hanger loads and equipment loads are provided by other disciplines or equipment supplier, such as mechanical, electrical and etc.

7.2.3.3 Crane load

The crane load will be determined according to "Load code for the design of building structures GB 50009-2012".

7.2.3.4 Wind load

According to the input from the OWNER (162 km/h (to be confirmed))

7.2.3.5 Seismic action

According to the input from the OWNER, the peak ground acceleration (with 10% probability of exceedance in 50 years at site) is 0.16g(to be confirmed). Seismic action will be computed using either of the following two methods: (1) Base shear method; (2) Response spectrum method.

7.2.3.6 Load combination

The load combination will be done according to the requirements of the Chinese GB codes.

7.2.4 Coal bunker building

The coal bunker building will be of steel structure. The transversal lateral force resisting system shall be designed of rigid connection frame with necessary bracings. Longitudinal lateral force resisting system shall be designed of pinned connection structure, which consists of frame beams, columns & vertical bracings. The earthquake force and wind force structure shall be carried by vertical bracings.

The coal silo will be of steel structure.

The floor(exclude the roof)and platforms will be of reinforced concrete slab with permanent metal deck or non-skid gratings.

7.2.5 Coal handling system

The buildings and structures for the coal handling system consist of coal conveyer trestle, coal transfer towers, coal transfer tunnel, coal crusher house and so on.

Coal transfer tower, crusher house, mechanical sampler building, coal conveyor trestle and coal handling control house are designed of steel structure.

The underground transfer tunnel is R.C structure.

The Crusher Pedestals will be of reinforced concrete block set on springs and dampers in order to isolate vibration.

7.2.6 Support Steel Structure of Flue Gas Duct

The support structures of flue gas duct will be designed of steel structure and provided by SEC. The steel structure will be designed according as Chinese standard.

7.2.7 Steel Structure of Elevator Shaft for Boiler

The steel structure of elevator shaft will be designed according as Chinese standards.

7.2.8 Chimney

A chimney with two self-support steel flue duct inside the R.C shell will be designed for this power plant. The inside steel flue is about 210m in height and 7.5m in diameter. The outside windshield shell has a height of about 205m. Coating and painting of the chimney shell with alternate "red" and "white" colour bands will be provided, and shall satisfy the owner aviation requirements.

7.2.9 Foundation

According to the preliminary soil investigation information, the opening R.C foundations carried by natural soil are adopted for the Coal Bunker building, Coal handling building and structure, support structure for duct, Chimney

The final soil treatment method (if necessary) and the type of foundation may be revised in the next stage since more soil information will be provided.

7.3 Heating, Ventilation and Air Conditioning (HVAC) Systems

7.3.1 Design Criteria

The Lalpir & Pakgen 2x365MW power plant is located around 45 KM to the west of Multan, Pakistan.

The coordinates are: Latitude—30°10'23"N, Longitude—70°59'35"E.

Based on the climate condition that supplied by 2009 ASHRAE Handbook—Fundamentals and the tender document (Attachment 3.2A Meteorological and Appendix-I-Technical

Specification-7.3- Heating, ventilation and air-conditioning (HVAC) systems). The external psychometric conditions to be used for designing the HVAC systems are as follows:

a, Outdoor design temperature for summer ventilation: 43.2℃

b, Outdoor design dry-bulb temperature for summer air conditioning: 41.8℃

c, Outdoor design wet-bulb temperature for summer air conditioning: 23.5℃

d, Outdoor design temperature for winter air conditioning: 5℃

7.3.2 Scope of Design

- Air Conditioning system -

Ventilation system

- Dust Extraction & Dust Suppression system for Coal Handling Plant

- Vacuum cleaning system

7.3.3 System Description

7.3.3.1 Air Conditioning System

Air-cooled split type air conditioner will be provided for the Local Control Room, Office and Rest room, etc.

7.3.3.2 Veotilation System

Ventilation system of natural air intake and mechanical air exhaust will be provided for the compressed air plant, pump house, water treatment plant and closed coal conveyor, etc. to remove indoor harmful gases or excessive heat.

7.3.3.3 Dust extraction & dust suppression system for coal handling plant

The coal bunker bay dust extraction system is to dilute or extract the methane accumulated at the upper portion of the bunker bay and keeps the bunker bay always under negative pressure to reduce dust dispersing during unloading coal. The fans and motor will be explosion-proof type. This system will be interlocked with the associated coal control plow, and it also can work timing.

Dust Extraction system will be designed for Crusher house, all coal transfer towers after Crusher house and Coal Bunker.

Conveyor transfer points will be provided with dust suppression water spray to keep dust to a minimum.

7.3.3.4 Vacuum cleaning system

The scope of the vacuum cleaning system will cover Boiler House and Coal Bunker bay.

The main equipment of the vacuum cleaning system is a vacuum dust suction truck (1x100% capacity of vacuum dust suction truck will be supplied).

The vacuum cleaning system including the following parts: stationary vacuum cleaning equipment (one set for each unit) and independently stationary piping network.

The Vacuum cleaning equipment is stationary, and its dust container can be taken-down. The main performance parameters of it are as follows:

Maximum vacuum pressure: -88kPa, Rated suction distance: 200m, Maximum suction distance: 250m, Cubage of dust container: 5 m3.

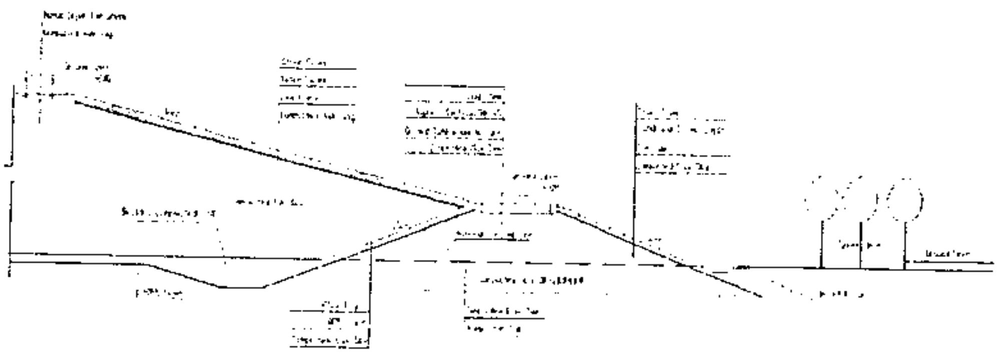
It is allowable that less than 4(2") suction nozzles can be put into use meantime in the vacuum cleaning system.

Piping network consists of steel pipe and steel fittings. The independently stationary piping networks will be provided in the following locations: Boiler Hall (Top Floor) and Coal Bunker Bay.

All sorts of flexible hoses and suction nozzles will also be provided along with the stationary vacuum cleaning equipment. The vacuum pump in the stationary vacuum cleaning equipment can be started after the operator connected the hose with the fast adapter in the piping. Then the operator can hold the suction nozzles to clean the dust on the equipment, pipes and floors.

7.4 Ash Disposal Site

There's no ash disposal area topographic map So it's assumed that the ash disposal area is a plain ash pond. Soil embankments shall be laid around the ash pond. the height on the top of soils embankment is assumed to be 3 m, the final height of dumping of the ash slag shall be 6.0m,and the corresponding ash storage capacity shall be approximate 0.06 million m^3. it can store ash slag for over 30 days, the land acquisition area of ash yard is approximately floor 2.9×10^4 m^2. the bottom of ash yard shall be paved impervious film to prevent soil and ground water from polluting. Machines and tools shall be provided for dumping of ash slag.



SECTION 8 ELECTRIC

8.1 Generator

The Existing generator shall be utilized.

8.2 Electrical Primary Part

8.2.1 Utilizing the Existing Equipments

Generator, 220kV GIS, Generator transformer, Unit auxiliary transformer, Start up transformer, the 11kV switchboard, 380V switchboard, diesel generator and so on shall continue to run.

8.2.2 Main Equipments

8.2.2.1 Unit auxiliary transformer (new)

Rated Power: 20MVA(pending)
Type of Construction: Outdoor, oil-filled

Type of Cooling: ONAF

Rating voltage: 24kV±2x2.5%/11.5kV

Tap changer: off circuit

Rated Frequency: 50Hz

Vector Group: Dyn11

Impedance voltage: 10.5%(pending)
L.V Neutral: earthed by resistance

8.2.3 MV-LV single line diagram and equipment selection

8.2.3.1 MV single line diagram

One 20MVA two windings unit auxiliary transformer (UAT) is set for each generator unit. Two 11kV unit buses (A, B) are provided for each unit, which is fed from corresponding generator output terminal through unit auxiliary transfomer. 11kV unit motors and all LV Auxiliary transformers in couples are connected to 11kV unit section A and B separately. And 11 kV station loads are also connected to 11kV unit section 1(2)A and 1(2)B.

According to the drawing supplied by owner, one 44MVA start up transformers is set for each unit. For lack of the existed start up transfonner capacity selection list, the capacity shall be checked after award the contract. In bidding stage, the new start up transfonners shall not be included and supplied. And short circuit current of 11kV switchgear is considered as 40kA tentatively, after receive the existed start up/standby transformer capacity selection list, the short circuit current shall be decided by calculation.

The MV single line diagram refers to Drawing No. AF439K-D01.

8.2.3.2 380V PC/MCC and distribution panels

The PC (power centre) and MCC (motor control centre) connection mode is used for 380V system within power plant.

LV service transfonners are set up in couples, and they are connected to 11kV unit separately, standby for each other.

The PC will distribute power through feeder breakers to large 380V motors and to MCC and to some loads not far away. The MCC will distribute power to 380V motors with rating power≤75 kW, to AC distribution boards and to intermediate 380/220V loads. The 380/220V AC distribution boards will distribute power to even small 380/220V loads.

According to the drawing supplied by owner, one 1000kW diesel generator is set for each unit. For lack of the existed diesel generator capacity selection list, the capacity shall be checked after award the contract. In bidding stage, new diesel generators are not considered and supplied.

In normal condition, the emergency MCC normally receive power from unit PC section. When the emergency condition occurs that there is no power available from the unit PC section, the diesel generator will start up automatically and supply power to emergency loads.

The 380V system neutral point is solidly grounded.

The LV single diagram refers to Drawing No. AF439K-D01.

8.2.3.3 Selection of auxiliary power equipment

The 11±2x2.5%/0.4kV transformer is dry type for all plant.

For 11kV power system, draw-out vacuum circuit breaker is adopted. 11kV switchgear's Interrupting current: 40kA (rms) and Dynamic stability current is 100kA (peak).

Both the 380V power centre (PC) and motor control centre (MCC) or distribution panel are of draw-out or fixed type with short circuit withstand current 50kA.

Draw-out/fixed type air circuit breaker(ACB), electrically and mechanically operated, stored energy, trip free, will be with provisions for padlocking in the open (off) position for incomers, bus couplers. Moulded case circuit breakers (MCCB) are adopted for other feeders.

Normally, Motors with rating power >75kW and <180 kW are supplied power from PCs, Motors with rating power≤75 kW are supplied power from MCCs.

8.2.4 Electric equipment layout

8.2.4.1 Layout of unit transformer

New adding unit auxiliary transformers are located outside column A. The 11kV sides of unit auxiliary transformers are connected to 11kV unit switchgears through 11kV cable.

8.2.4.2 11kV AND 380V SWITCHGEAR

The 11kV unit section is located in #5 coal transfer tower close to coal bunker bay. And the protection degree is IP42 for 11kV Indoor Switchboards.

Boiler PCs, lighting MCCs, maintenance MCCs, boiler emergency MCCs are located in #5 coal transfer tower close to coal bunker bay. Other PCCs and MCCs of BOP are centralized and placed at corresponding power load centre (indoor). And the protection degree is IP42 for LV Indoor Switchboards.

8.2.5 Lightning protection and earthing

The lightning protection and grounding design is in order to prevent the equipment and person from hurt by over voltage and short circuit current.

8.2.5.1 Lightning protection system

The lightning design standard is based on IEC 62305 or Chinese standard. Lightning protection system will be comprised of lightning rod, lightning conductor, down leading conductors and so on.

8.2.5.2 Earthing

The earthing design standard is based on IEEE Std 665 &IEEE Std 80 or Chinese standard.
All earthing conductors shall be copper.

8.2.6 Cable, cabling and cable fireproof

8.2.6.1 Cable selection

a) MV single core and multicore power cables rated as 11kV will have copper conductor, XLPE insulation, PVC inner sheath, steel or Al wire armoured and have outer sheath PVC with flame retardant.

b) LV single core and multicore power cables will be 0.6/1kV rating, copper conductor, having

XLPE insulation, PVC inner sheath, steel or Al wire armoured and have outer sheath PVC with flame retardant.

8.2.6.2 Cable support

The cabling structure is mainly overhead cable tray assisted with cable trench.

All cable trays are hot dip galvanized steel type. There is a maximum spacing of 2000mm between cable tray horizontal supports and 1500mm between vertical supports.

The cable pass-way between main building and auxiliary plant is overhead cable tray or cable trench.

Cable racks are used in the Cable trench. The cable conduit is of hot galvanized steel pipe type.

8.2.6.3 Cable fire proof

In the main passage-way, fire proof cable trays, fire proof wall of bag filled with fireproof material or fireproof barrier-layers are set up. Sealed fireproof material is done at inlets of switchgear, cable shafts and two ends of cable conduits. Fireproof wall with fireproof bag of cable trench is set up at the entrance to building.

8.3 Electrical Secondary Part

8.3.1 DC Supply System

220V DC power supply is supplied for supplying power to essential boiler and BOP auxiliaries, control, protection, interlock and annunciation. As such the following shall be.

1×100% set of 220V valve-regulated lead acid type batteries with associated SMPS based modular float cum boost charger for each the remold unit.

1×100% set of 220V valve-regulated lead acid type batteries with associated SMPS based modular float cum boost charger for Coal Handling plant.

8.3.2 Boiler Uninterrupted Power Supply System (UPS)

One set of Boiler UPS system shall be provided for each boiler AC consumers which shall not tolerate any power supply interruption such as boiler DCS, I&C system etc. The output shall be 220V, single phase, 50Hz. The DC power source would come from the 220V UNIT DC system.

Each UPS consists of the following major components:

1×100% inverters

1×100% capacity static switches

One manual by-pass switch

1×100% floats-cum-boast Chargers

Distribution boards

Other accessories

8.3.3 Electrical Control, Protection And Metering

8.3.3.1 Control

In principle, new added electrical main plant system shall be supervised and controlled in boiler DCS.

The electrical equipments which shall be supervised or controlled in boiler DCS are as follows:

- Unit transformer (NEW UAT-1~2)
- 11kV auxiliary power system (11kV Unit Section 1A~2A, 1B~2B)
- 400V auxiliary power system (Boiler PC Section)
- Boiler UPS (only supervised)
- 220V UNIT DC system(only supervised)

8.3.3.2 Protection

8.3.3.2.1 Unit transformer Protection

Complete protection system consisting of fully numerical protective relays, auxiliary relays, timers, etc., shall be provided to protect the Unit transformers (NEW UAT-1~2).

The protection shall comprise two 100 % redundant groups. Complete protection of the respective equipment shall be fully available even if either of the group is not available. Hence, groups shall be physically and electrically separate and independent. Each protection group shall receive all AC and DC input signals from separate devices systems. However, the output trip of each the relays group shall trip the respective circuit breaker through both trip coils I & II. The following protections shall be provided:

- Unit transformer differential protection (87UT)
- Unit transformers HV back up over current (51UT)
- Unit transformers LV stand by earth fault protection (51NUT)
- Unit transformers LV restricted earth fault (64RUT)

8.3.3.2.2 HV Switchgear

A digital type integrated protection and measuring equipment shall be provided for each 11kV motor and unit service transformer. The equipment provides integrated control, supervisor, measurement and protection functions, and it is mounted in the HV switchgear.

For each 11kV bus bar incoming, over current protection shall be provided.

Protection functions for feeders:

Outgoing Feeder: instantaneous over current, time delay over current, earth fault.

Transformer feeder: HV side over current(instantaneous & time delay). HV side zero-sequence over current, LV side zero-sequence over current.

Motor feeder: Differential Protection(only for motor rated 2000kW above). over current(instantaneous & time delay). zero-sequence over current , Locked-rotor protection, thermal protection, under voltage.

8.3.3.2.3 LV Switchgear

For 400/230V incoming, bus-tie and MCC feeders, short-current and over-current protections shall be realized by circuit breaker release.

For 400/230V motor feeders, the short-current and over-current protections shall be realized by breaker release and thermal overload protection shall be realized by thermal relay.

Protection functions for feeders:

Incoming feeder: time delay over current(two stage);

Bus tie feeder: time delay over current(two stage);

MCC feeder: time delay over current(two stage), earth fault;

Motor feeder: instantaneous over current, time delay over current, thermal, earth fault over current(only for motor rated 55kW and above)

8.3.3.3 Metering

The current, watt, var of UT shall be measured through respective transducers, and corresponding 4~20mA signals shall go to boiler DCS. The transducers shall be mounted in the UAT relay panel.

For HV motor and transformer feeders, measurement shall be through the integrated protection and measuring equipment mounted in the switchgear. A single phase current shall go to DCS through hardwired wiring with 4~20mA port.

For LV incoming feeders, feeding feeders(only main plant area) and important motor feeders, a single phase ammeter with transducer output shall be provided in the swichgear. And the same current shall go to DCS or related control system through 4~20mA port.

For 400V PC feeding feeders, a single phase energy meter shall be provided in the switchgear.

For 400V bus bar, a line to line voltage meter with transducer output shall be provided in the busbar PT swichgear. And the same voltage shall go to DCS or related control system through 4~20mA port.

8.3.3.4 Change-over Mode of Auxiliary Power System

In normal operation, manual parallel change-over mode shall be adopted for HV auxiliary power system. In accident condition, high-speed serial change-over mode is adopted and realized through a dedicated high-speed transfer device.

For LV bus coupler, automatic transfer scheme shall be adopt and realized through configuration of DCS or control system logic program.

8.3.3.5 Coal handling Control System

One set of coal handling control system shall be provided for control and supervision of coal system electrical equipments,including a LCD-KB man-machine interface system located in coal handling control room.

Coal handling control system shall use the same hardware with the main control system as a consistency point of view.

Meanwhile, one set of Coal handling industry TV system with communication port shall be provided for supervision of important equipment or places of coal handling system.

The equipments of coal handling DCS system and Coal handling industry TV will be located in coal handling control room.

8.4 Lighting and Maintenance Power System

8.4.1 Normal Lighting

The normal A.C. lighting system shall be provided for throughout the plant, The A.C. lighting system shall be of 380/220 V, three-phase and four-wire, 50HZ, neutral directly earthed system. The voltage for lamp shall be of 220V.

The normal lighting of main building is power supplied by the newly increased 380/220V normal lighting section feed from the original lighting transformer.

The lighting of other auxiliary building is supplied by the PC or MCC nearby.

8.4.2 Emergency Lighting

The emergency A.C. lighting shall be arranged in important areas of main building. The emergency A.C. lighting is power supplied by the emergency section.

The exit sign lamp shall be installed on the main building's entrance and staircase and main channels. The lamp with self-contained battery is used for the emergency lighting in isolated areas, such as the water supply system and the other auxiliary buildings.

8.4.3 Maintenance Power

The maintenance power box shall supply to welding machine and the other electric tool. The maintenance power supply system shall be of 380/220V three -phase and four- wire, 50HZ, neutral directly earthed system. The maintenance power of main building is power supplied by the newly increased maintenance section.

The maintenance power for the water supply system and the other auxiliary buildings is supplied by the PC or MCC nearby.

8.5 Communication System

8.5.1 System Description

The Communication System will provide station personnel with a reliable and convenient means for voice and data communications.

Major Components

The Communication System will consist of the following major subsystems:

- PABX System.
- Public address system.

- DC -48V Power supply

8.5.2 PABX System

One PABX system of the programmable type for 400 extensions and 40 exchange lines and the necessary telephone sets will be provided for the plant.

The Telephone system will provided telephone communication among designated locations in the various buildings of the plant and will interconnect with the public telephone network.

The Telephone system will consist of the following compnnents.

- Telephone switching equipment (PABX)
- Main distributing frame (MDF)
- Telephones
- Modular jacks

8.5.3 Public Address System

The public address system will be designed to provide station personnel with a reliable means of plant paging and voice communications.

The public address system is a modular industrial communication system. The system consists of amplifier assemblies (station) driving paging loudspeakers and telephone type handsets for party-line communication. It also has line balance assembly a power distribution panel.

The public address system will consist of the following major components.

- Line balance system
- Handset stations
- Paging speakers and amplifiers
- Interconnecting cable

8.5.4 DC -48V Power supply

One set -48VDC power supply system will be installed in the communication equipment room of the power plant to supply power to PABX. The DC system consists of a set of -48V DC power equipment, a 48V DC distribution cabinet and a set of 48V/300Ah batteries.

SECTION 9 CONTROL AND INSTRUMENTATION

9.1 General

The new DCS should control the new Boiler island, and provide the necessary signal to Turbine part through hardwire. While the final centralized and coordination control should be completed by existing DCS.

Auxiliary plants instrument and control system shall be based on PLC. Control system for auxiliary plants water, ash regions and local testing and operator console will be arrangement at local control center. Central control and monitor will be implemented in CCR by operator console.

The objective of the control systems is to facilitate plant operations, personnel safety, equipment protection, adequate operation, and plant availability. The control systems criteria are met by incorporating the following design features;

- Centralized control and monitoring
- Reasonably consistent operator interface
- Redundancy of key critical components

9.2 Scope for Engineering

Instrumentation and control system for the Project involves the control and supervisory of boiler and their associated auxiliaries, auxiliary plants or system etc. including as follows:

1)Main plant part: Instrument and control of boiler and their associated auxiliaries

2)Instrument and control of air compressor system

3)Water treatment system: Instrument and control of make-up water and Coal contaminated Waste water treatment system, Service water system etc..

4)Ash handling system: fly ash handling system, bottom ash handling system etc..

5)Fire detection and alarm system

6)Closed circuit television system(CCTV)

For the turbine-generator and their associated auxiliaries, the cable, cable trays, instrument, power supply, the marshaling cabinets, IO cabinets, DCS controller, operator stations and so on will be retained.

For the others existing system like as the SWAS, chemical dosing system, circulating water system, fuel oil system and so on, it will keep on the intrinsic control mode.

For the Fire detection and alarm system and Closed circuit television system will be provided in the new Boiler and new Auxiliary plants.

9.3 Terminal Point

Instrument and control scope correspondence with mechanical part.

If both end equipments/devices/Jounction Boxes are supplied by SEC, then supply of Control and Instrumentation cable shall be in SEC's scope.

If any end equipment is supplied by Owner, then supply of Control and Instrumentation cable shall be in Owner's scope. Terminal point at bidder"s side.

9.4 System Description

9.4.1Control Room

The Central Control Room and Engineer Room etc. will be used the existing control building. The Unit Control Desk (UCD) and the Fire detecting and alarm Panel (FP) will be arranged in the Central Control Room. Dperator stations with color LCD/Keyboards of DCS will be located on the UCD. In addition, LCD/Keyboards, a few push buttons will be provided and located on the UCD for emergency shut-down the units.

In the Engineer Room, engineer working station (EWS) of DCS will be located.

In the Control Equipment Room, there will be DCS (Distributed Control system) cabinets. Flame Scanner cabinets and tube leakage detective cabinets and so on. The layout of the Control Equipment Room should be completed by SEC.

The boiler power distribution cabinets and soot-blower cabinets will be located in local.

9.4.2 The Functions of DCS

The applicable functions of DCS will include DAS (Data Acquisition System), MCS (Modulating Control System), SCS (Sequence logical Control System), FSSS (Furnace safety supervisory system).

9.4.2.1DAS (Data Acquisition System)

Acquisition, data processing, performance calculation, alarm, LCD display, SOE (Sequence Of Events), tabulation & printing and operating guide of the input data and storage & retrieval of the historical data can be accomplished for the process by the system.

9.4.2.2MCS (Modulating Control System)

The main items of automatic control will be considered as following:

- Boiler master control
- Furnace Air flow control
- Furnace pressure control
- Primary air pressure/flow control
- Forced air pressure/flow control
- Gravimetric feeder control
- Super heater temperature control
- Reheater temperature control
- Fuel oil flow/pressure control
- Feed-water flow control

Brief description for control system written follow are only for reference, final requirements will be prepared by mechanical part.

9.4.2.3SCS (Sequence logical Control System for auxiliary equipment)

The control scope will include the main auxiliary equipment, valves, auxiliary power system and generator-transformer system in the main building. The sequence control based on the subgroup of functions for the auxiliary equipment will be reached.

- Primary fan system
- Forced draft fan system
- Induced draft fan system
- Lignite feeder system
- Slag handling system
- Combustion chamber and bottom ash handling system
- Boiler blow down and Drain system
- Soot-blower control system
- Others

9.4.2.4FSSS (Furnace safety supervisory system)

FSSS will be a part of DCS, and redundant processor modules will be required. The design of FSSS will conform to the NFPA standards 85, regulation and boiler manufacturer's requirement. The FSSS will also be provided with interfaces with CLCS, OLCS and other control sub-system, and can also receive and send out information and command required by the integration of the whole unit operating conditions.

The FSSS will be provided emergency tripping measures for fuel oil quick closing valve, coal feeder, mill, etc., the tripping function will be performed by hardwire connected.

The FSSS will include burner control system (BCS) and fuel safety system (FSS), which permits the safe start-up operation and shutdown of boilers. It interfaces with field devices that are primarily digital (on / off), and executes sequential control logic utilizing flame monitoring devices (i.e., flame scanners, pressure switches, limit switches, etc.) to determine boiler flame status.

The following brief functions will be provided in this FSSS system:

- Furnace auto purging
- Put in / cut out and monitoring of igniters
- Put in / cut out and monitoring of the fuel oil and coal
- Flame monitoring
- Oil leak-out test
- Furnace pressure protection
- Main fuel trip (MFT)
- Air damper control
- Primary air, flame detected, cooling air and sealing fan control

BCS major system functions requirement include:

- Continuous monitoring of the safety ignition, operation and cut off for oil and coal burners.
- Grouped initiation of ignition and shutdown
- Flame detection
- Supervise and control mill and / or burner start-up and shutdown sequences
- Before obtaining the allowable condition of FSS the burner control will not feed fuel or ignition energy into furnace.
- When MFT signal is received, the burner control system will cut off fuel and ignition energy from the furnace quickly in coordination with FSS according to command.
- Processor for BCS will be dual Redundant (Hot Standby) and input / output module will be single configured.

FSS major system functions requirement include:

- Boiler Purge
- Main Fuel Trip (MFT) Condition & OFT
- Oil leakage test

FSS known as boiler protection is designed with a fully triplicate, fault tolerant architecture throughout called TMR, from the input modules through the main processors to the output modules.

9.5 BOP Control Auxiliary system of BOP will be designed and supplied; The PLC shall be used for Auxiliary system. Three main local testing equipment rooms and control systems will be envisaged according to coal area, ash area, and water area. Control and monitoring operator station of auxiliary system will be arranged in CCR.

1) Water treatment system control room layout: The water treatment system testing room will be set in boiler make up water treatment plant. There are testing and operators working station, water control net system cabinets, control cabinets etc in the room. The remote IO cabinet for water treatment system will be mounted locally.

2) Ash handling system control room layout: The Ash handling system testing room will be set in ash handling control building. There are testing and operator working station, ash control cabinets etc. in the room. The remote IO cabinet for Ash silos will be mounted locally.

3) Coal handling system control room layout: The Coal handling system testing room will be set in Coal handling control building. There are testing and operator working station, ash control cabinets etc. in the room. The remote IO cabinet for coal handling system will be mounted locally.

9.6 Flue gas temperature probe

Two (2) numbers of retractable type temperature probes with duplex type elements at the furnace outlet, complete with all accessories like guiding supports, cooling arrangement, motor with position indication etc. will be provided.

The control signal will be come from DCS system, furnace gas temperature and position of globe will be indicated in operator station of DCS system.

9.7 Soot blower control

The boiler will be provided with a complete set of a programmable automatic sequential steam operated wall blowers for cleaning the furnace water walls, and soot blowing equipment for cleaning the superheater, reheaters, economizer and air heater while boiler is in operation.

The brief functional requirements of Soot Blower System are as follows: -

- Automatic sequential start of each soot blower.
- Selection facility for individual soot blower for automatic sequential
- Operation / manual over-riding of automatic operation.
- Capability of disable the operation of any soot blower, if required.
- Indication of the soot blowers in operation.
- Monitoring all essential parameters of the soot blowing system.
- Indication of any malfunctioning of soot blower.
- Pressure and Temperature interlock with automatic retraction of the soot blower.
- Steam pressure control.

Control circuits of the retractable soot blower shall be designed so as to prevent insertion of blower nozzles in the combustion chamber unless soot-blowing steam is available. The complete logic of Soot Blowing system will be implemented in DCS with all required field instrument wired herein.

9.8 Industrial TV

Drum level industrial TV and Furnace industrial TV shall be supplied by boiler manufacturer.

9.9 Flame Scanner and Flame Scanner Cooling Air System

The Flame Monitoring System (FMS) will include flame detectors of proven type conforming to NFPA recommendations with solid-state logic circuits. FMS is capable of discriminating between oil and coal flames. The flame monitoring amplifier will generate 4-20mA DC signals corresponding to flame intensity and also digital outputs. Outputs of FMS will be fed to DCS for control and monitoring. Complete cooling air system for the flame scanners will consist of 2×100% capacity AC electric motor driven scanner air fans.

9.10 Instruments

The field local devices and instruments will be provided to meet the control function requirement for unit startup, continuous running and safe shutdown. The instrument offered will be as per industry standard and meeting all applicable code requirements.

There will be hazardous area classification for the entire plant. All the C&I equipments and instruments will be procured complying with the applicable area classification.

The transmitters (PT, DPT and FT) will be installed in Local Instrument Rack (LIR). The grouping of transmitters will be done as per location and elevation of tapping point on main process piping.

9.10.1 Flow Instruments

For measurement of flow of various fluids, following guide lines will be considered. For water services, flow nozzles or orifices or other suitable will be used according to requirement. Mass flow meter will be used for oil measurement. For air flow measurement venturi, aerofoil and other insert flow measurement will be used.

9.10.2 Level Instruments

For local level indication, float board / gauge, magnetic turn over level gauges will be used. The level transmitter will be provided for important vessel.

Type of level instrument which may be used in this project includes as follow:

·Float /Conductivity Type Level Switches

·Magnetostrictive level type/Guided Wave Rader type Instruments

9.10.3 Temperature Instruments

In general, temperature instruments will have scales with temperature units in degrees Celsius. Temperature gauge dial size will be 100mm generally. However, the dial size of gauges supplied by any package vendor will be as per their manufacturing standard. Thermometers for local mounting will be bimetallic type.

Resistance temperature detectors (RTD) will be of the 3 wire platinum duplex type. The nominal resistance of the RTD will be 100 ohms at 0 C.

Thermocouples will be un-grounded; chromel-alumel (ISA Type K or E) or other type will be used with respective extension wire.

Generally, the process connection thread size will be M33x2 for most of the application. For low pressure and small pipe size application, M27x2 size of thermowell will be used. However, welding connection will be employed for high pressure and high temperature application.

The motor bearing and winding temperature will be measure by using Pt100 RTD and wired directly to DCS. All alarm and protection required will be implemented in DCS drive control logic.

9.10.4 Pressure Instruments

In general, pressure instruments will have scales with pressure units in MPa, kPa, Pa. Pressure gauge dial size will be 100mm generally. However, the dial size of gauges supplied by any package vendor will be as per their manufacturing standard.

9.10.5 Field Mounted Process Switches

Field-mounted process switches include the switches used for pressure, level and temperature application. These devices will be used either for binary control logic for alarm purpose in DCS. The switch housing will be suitable for the environment and process application.

SECTION 10 SCHEDULE 3 PERFORMANCE GUARANTEES

No.	Parameter	Condition	Value
1	Boiler Efficiency	Boiler efficiency (LHV) at 100%BTMCR, with 25 ℃ ambient air temperature while firing design coal at rated steam parameters at superheater outlet and rated coal fineness and rated excess air, bottom and fly ash extraction stabilized, blow-down at zero.	**88.5 % as per PTC4.1**
2	Minimum duration of stable load without oil support	design coal firing	40% BMCR

哈电集团

哈尔滨电气国际工程有限责任公司

HARBIN ELECTRIC INTERNATIONAL COMPANY LIMITED

COVER LETTER

May 30, 2014

To: Lal Pir
Near Mehmood Kot
Muzaffargarh
Pakistan

From: Harbin Electric International Company Limited
No. 39 Sanda Dongli Road, Xiangfang Dist, Harbin, China

Dear Sir,

First of all, we would like to extend our warmest greetings and best wishes to your esteem company. Also we are very pleased to learn that your esteem company is preparing to build the Fuel Conversion Project of Lal Pir (362MW) Power Plant in the District Muzaffargarh of Pakistan.

With the most valuable project information and project guidelines, We, **Harbin Electric International Co., Ltd (HEI)**, a company specialized in EPC contracting and equipments manufacturing from China would like to take this opportunity to express our keen intention & interest to participate and be involved in the above mentioned project.

As the subsidiary of **Harbin Electric Corporation (HE Group)**, HEI is one of the biggest companies in China for supplying complete equipments to power plant and undertaking EPC projects on Turnkey basis covered thermal power, hydropower, wind power and transmission lines. HEI is a professional company to serve as the EPC contractor for power plant projects in Chinese power market as well as overseas market, such as Pakistan, the Philippines, Vietnam, Bangladesh, Cambodia, Iran, Sudan, India, Indonesia, Turkey, Ecuador etc. We take advantage of manufacturing ability, high quality, reasonable cost, short construction duration, satisfactory service, and good reputation to carry out every project. Through different kinds of power projects built and under construction, we have established an extraordinary reputation of high reliability and flexibility to satisfy our customers.

Hereby, we submit our bid proposal for the above mentioned project. We hope our bid proposal will be satisfactory to you, and we will be pleased to provide any supplemental documents and information as per your request.

Please feel free to contact us and we are always at your service.

Contact person:

Mr. Zhao Linnan tel: +86-451-82871720 e-mail: zhln@china-hei.com

Mr. Zou Hongliang tel: +86-451-82871727 e-mail: zhlwinner@163.com

Best Regards!

Zhao Linnan

Deputy General Manager of 1st Marketing Department

Harbin Electric International Co., Ltd

COMMERCIAL TERM SHEET

FOR

PAKISTAN LAL PIR POWER PLANT
FUEL CONVERSION PROJECT

May 2014

g that the LAL PIR wish to make replacement of its own oil fired 200 ton/hr) built at District Muzaffargarh in Pakistan (362MWe power plant R)), by a pulverized coal fired power plant and Harbin Electric International Co. aving their registered office at No. 39, Building (B), San Da Dongli Road, Xiangfang st., Harbin, China, has expertise in the field of EPC for fuel conversion of electric power projects and has evidences for substantiating their experience, required financial resources to undertake such projects.

The provisions in this term sheet (this "**Term Sheet**") reflect the terms and conditions upon which the parties intend to base an agreement (the "**EPC Contract**") for the design, engineering, procurement, civil, construction and commissioning of the project (as defined below) (the "**Project**").

S. N	Article	Details
1	Parties to Contract	Employer: LAL PIR (hereinafter referred as "the Employer") Contractor: Harbin Electric International Co., Ltd. (hereinafter referred as "the Contractor")
2	Project	Pakistan LAL PIR Power Plant Fuel Conversion Project (hereinafter referred to as "the Project")
3	Scope of Contractor's Work	The Work on EPC basis includes design, engineering, procurement, civil work, construction, commissioning and testing as per technical specification plus FGD. The current price excludes foundation treatment, piling, demolition work, disassembly & removal, relocation, which will be discussed during detail negotiation period. The Employer shall provide disposal area within 1kM from the boundary of the Site.
4	Conditions of Contract	The Conditions of Contract shall be based on this Term Sheet and the details shall be discussed between the Employer and the Contractor during the Negotiation Period.
5	Price & Validity	The proposed quotation for above mentioned scope of work is **USD 256,000,000 (Say US Dollar Two Hundred Fifty Six Million Dnly)** excluding Spare Parts and the final Contract Price will be mutual agreed according to scope of work and all technical specifications are clear and specific and is subject to variations therefore as may be made under the conditions of the Contract. Our quotation shall be valid from May 30, 2014 until November 30, 2014.
6	Factory	The Owner will be responsible for the cost of Review Party during the inspection and testing.

S. N	Article	Details
	Acceptance Test	
7	Consumables (lubricants and chemicals)	During commissioning and testing period, the Contractor will provide the first fill of lubricants and chemicals to the equipment, the Employer will be responsible for re-filling up and maintaining.
8	Taxes and Duties	Other than the incoming tax of the Contractor's personnel, the Contract Price is exclusive of any taxes, duties, fees or similar charges in Pakistan.
9	Licenses and Permits	Each Party shall acquire and pay for the permits, approvals and/or licenses from all local, state or national government authorities or public service undertakings in the country where the Site is located which require the responsible Party to obtain in the responsible Party's name. Notwithstanding abovementioned, the Employer shall be responsible for the Import permit. Detail list will be discussed by the Parties during negotiation period.
10	Water, electricity	The Employer shall provide water and electricity on chargeable basis at the connection points during construction period within one meter of the power plant fence, which shall meet the requirements of the construction. The Employer shall be responsible for the connection to the grid six month before pre-commissioning and provides following items during commissioning & performance Tests free of charge: Fuel (coal and oil and Limestone) Electricity and water As may be reasonably deemed to carry out such tests efficiently.
11	Project Completion Schedule	Calculated from Contract Commencement Date to Taking-Over Date: 35 months
12	Effective Date	The Contract shall become effective on the date of signing the Contract.
13	Commencement Date	The date for Commencement of the Contract shall be the date of issuance of Notice to Proceed which shall be issued within 7 days after the following conditions have been fulfilled: (i) The Financing Procedures with the relevant financial institutions have been finalized and the Loan Agreement becomes effective (the Employer has provided to the Contractor a notice from the Lenders confirming that the

S. N	Article	Details
		financing is available for disbursement in accordance with the financing agreement); (ii) 15% Advance Payment Guarantee and 10% Performance Guarantee has been provided by the Contractor to the Employer; (iii) Full amount of advance payment have been paid to the Contractor by the Employer; (iv) Opening irrevocable Letter of Credit acceptable to the Contractor by the Employer which is equal to 85% of the Equipment Supply of Contract Price (if any); (v) All statutory and regulatory approvals, permits have been obtained by Employer from the Government, including without limitation, import permit, environmental permit, land acquisition, construction permits, etc which are required for the commencement of the Works as per applicable laws; (vi) The Employer has granted the Contractor the right of access to, and procession of, all parts of the Site with associating rights of way for the performance of the whole of the Works; (vii)The necessary conditions available at site for commencement of the Work, such as access road, leveling and clearance of site are completed, site preparation have completed as per the Contract, the Employer has confirmed the supply point of electricity, water for construction the Works within 1 meter from the boundary of the Site; (viii) Disposal area has been provided 1kM from the boundary of the Site. If Commencement Date does not occur within 90 days after Effective Date due to Employer's failure to fulfill any of his obligations stated above, the Contractor shall be entitled to adjust the Contract Price and time schedule.
14	Performance Bank Guarantee (PBG) & Warranty Bond	The Performance Guarantee shall be issued by a first-class Chinese Bank and the total amount is 10% of the Contract Price. The Performance Guarantee shall come into full force from the Commencement Date until the earlier of the following date: (a) the date upon the Taking-Over Certificate is issued pursuant to the Contract; Dr (b) date/month/year (the date specified in the bank guarantee as the expiry date thereof) The Warranty Bond shall be issued by a first-class Chinese Bank and the total amount is 5% of the Contract Price. and the Warranty Bond will come into full

S. N	Article	Details
		force from the expiry date of the Performance Guarantee and the issuance of TOC of the Unit until the earliest of the following date: (a) expiration of the Warranty Period, Or (b) the date which is twelve (12) months after the date of issuance of the TOC; Or (c) date/month/year (the date specified in the bank guarantee as the expiry date thereof).
15	Advance Payment Bank Guarantee (APBG)	The Contractor shall submit, as a security towards the Advance Payment, equal to 15% of the Contract Price. The liability under this guarantee shall be automatically and irrevocably reduced by 15% of amount of each invoice of deliveries or services provided by the Contractor. The Advance Payment Guarantee will be issued by a first-class Chinese Bank and come into full force from the date upon which the Contractor has received the full amount of Advance Payment in accordance with the Contract until the earliest of the following date: (a) the date upon the Taking-Over Certificate is issued pursuant to the Contract; Or (b) the date upon which the amount of this guarantee is reduced to zero; Or (c) date/month/year (the date specified in the bank guarantee as the expiry date thereof).
16	Payment Terms	<u>**For Advance Payment:**</u> 15% of the Contract Price as advance payment shall be paid through T/T within 21 days after the Employer has received the APBG and PBG. <u>**For Equipment Supply (including design, engineering, procurement and shipment on CIF basis):**</u> (i) 5% of the Equipment Supply price shall be paid to the Contractor when the General layout drawing has been approved by the Employer. (ii) 10% of the Equipment Supply price shall be paid to the Contractor when the Main Equipment Contracts (BTG Contract) have been signed by the Contractor and the Manufacture against the copy of the sub-contract signing page and scope of work (without price). (iii) 65% of the Equipment Supply price of each shipment as per shipment documents shall be paid to the Contractor. (iv) 5% of the Equipment Supply price shall be paid when the Taking-Over Certificate is issued. Note: 85% of the Equipment Supply shall be paid through T/T if the project is

S. N	Article	Details
		financed by a Chinese Bank(s), in case for the other bank outside of Chinese bank(s), it will be paid by L/C. For Service (including civil, erection and commissioning): (i) 80% of the Service price shall be paid on monthly progressive work for civil and erection and shall be paid on milestone for commissioning in accordance with the mutually agreed Milestone Payment Schedule (the Employer shall not withhold any payment for the minor outstanding work and defects which will not substantially affect the use of the project for their intended purpose during testing). (ii)5% of the Service price shall be paid when the Taking-Over Certificate is issued Note: 85% of the Service price shall be paid by T/T. The Payment Schedule and the payment documentation shall be discussed and agreed by both parties during Contract negotiation.
17	Liquidated Damages	(a) Performance Liquidated Damages: The maximum Liquidated Damages for Performance Guarantees of the Power Plant shall not exceed 10% of the total Contract Price. (b) Delay Liquidated Damages: The maximum Liquidated Damages for delay of TDC of the Power Plant shall not exceed 10% of the total Contract Price. (c) Aggregate Liquidated Damages: The aggregate LD (total LD for Performance and LD for Delay) shall not exceed 15 % of Contract Price.
18	Warranty Period	12 months from the Taking-Over of the unit.
19	Insurance	Contractor shall at its expense take out and maintain in effect, during the performance of the Contract: (1) the Marine/Inland Transit insurance; (2) "workman's compensation" for Contractor's personnel; (3) insurance for Contractor's construction equipment;(4) EAR(Erection All Risks) insurance. The Insurer should be Chinese Insurance Company.
20	Arbitration	All disputes arising from, or in connection with the execution of the Contract, shall be settled through amicable discussion between both Parties. In case no settlement is reached, the disputes shall be submitted to Singapore International Arbitration Centre ("SIAC") for arbitration which shall be conducted in Singapore in accordance with its existing rule of arbitration. The arbitration award is final and binding on the both parties.

S. N	Article	Details
		The language of the arbitration shall be English.
21	Limitation of Liability for Contract	The Contractor shall not be liable to the Employer for loss of use of the Project, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the Employer in connection with the Contract. The total liability of the Contractor to the Employer, under or in connection with the Contract shall not exceed the Contract Price.
22	Governing Law	The Contract shall be governed by and construed in accordance with the Laws of England & Wales.
23	Codes and Standards	Chinese standards which are equivalent with the International standards will be applied to the Project.

For and on Behalf of Harbin Electric International Co., Ltd.

Zhao Linnan
Deputy General Manager
The 1st Marketing Dept.
Marketing Division

TECHNICAL DESCRIPTION AND DRAWINGS
FOR LAL PIR (362MW)
FUEL CONVERSION PROJECT

Harbin Electric International Co., Ltd (HEI)

TECHNICAL DESCRIPTION AND DRAWINGS
FOR LAL PIR (362MW)
FUEL CONVERSION PROJECT

Preliminary Technical Proposal	A	May,2014		
Description	Revision	Date	Compiled	Approved

Harbin Electric International Co., Ltd (HEI)

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GENERAL

Project Brief Introduction

The power plant is designed to burn the coal with a pulverized-coal fired boiler (PC boiler), the new PC boiler will instead the original boiler which is burning HFO, The steam pipes and water pipes will be redesigned and revised layout for connecting the new PC boiler, the equipments for new boiler will be designed for stability, safety and high efficiency operation.

The purpose of this proposal is to descript the design basis, system scheme, equipment choice, preliminary parameters designed for new PC boiler and the whole solution for fuel conversion.

Site Condition

Site Location

The power plant site is located near the town of Mahmud Kot, in the District of Muzaffargarh, Punjab Province.

Latitude: 30° 10'23"

Longitude: 70° 59'35"

The site elevation is approximately 117 to 122 m above mean sea level(MSL).

Geological Formation

Preliminary geotechnical study which included in the ITB is used to estimate the foundation part.

Meteorological

Introduction

Depending on the topography, there is an extreme variation in the temperature of Pakistan. The country is essentially arid except for the southern slopes of the Himalayas and the sub-mountainous tract where the annual rainfall varies between 760 and 1270 mm This area has humid sub-Tropical climate. In the extreme north - because of great heights - Highland climate prevails. The controlling factors of the climate are:

1. The sub-Tropical location of Pakistan that tends to keep the temperature high, particularly in summer.

2. The oceanic influence of the Arabian Sea that keeps down the temperature contrast between summer and winter at the coast.

3. Higher altitudes in the west and north that keep the temperature down throughout the year.

4. The Monsoon winds that bring rainfall in summer.

5. The Western Depression originating from the Mediterranean region and entering Pakistan from the west that brings rainfall in winter. These cyclones make a long land journey and are thus robbed of most of the moisture by the time they reach Pakistan.

6. A temperature inversion layer at a low elevation of about 1,500 m in the south during the summer, that does not allow the moisture-laden air to rise and condensation to take place.

District Muzaffargarh has extreme hot and cold climate throughout its area. A large area of the district consists of sand dunes and barren land. Almost all the area of thesil Alipur and some parts of Muzaffargarh tehsil are flooded each year.

Dry ambient temperature

Base 2005 to 2010 / in °C
Yearly mean 26.4
Maximum of monthly mean 43.7
Minimum of monthly mean 6
Mean of monthly maximum 32.7
Mean of monthly minimum 19.6
Absolute maximum 50.5
Absolute minimum -1

Atmospheric pressure

Base 2010 / in mbar
Mean 991.8
Mini 972
Maxi 1,013
Mean variation in one day 3.7
Minimum variation in one day 0
Maximum variation in one day 15

Rain fall

Base 2005 to 2010 / in mm
Mean yearly sum 265.4
Maximum yearly sum 474.8
Minimum yearly sum 171
Monthly mean 22.8
Maximum of monthly mean 64.5
Absolute maximum of monthly mean 175

Wind

Design wind speed will use 162km/h

Codes and Standards

The technical proposal is designed based on the following codes and standards
Emission limitation is fulfill the limits set force by the ITB, fire protection system is comply with the requirements of the NFPA Codes.

Except above codes and standards, the systems and equipments are designed, manufactured, erected and commissioning based on Chinese codes and standards.

The main Chinese standards and codes to be used are as follows.

Technical Code For Designing Fossil Fuel Power Plants	DL 5000-2000
Overvoltage protection and insulation coordination for AC electrical installations	DL_T_620_E-1997
Load code for the design of building structures	GB50009-2001
Code for design of steel structures	GB50017-2003
Technical Code For Stress Calculating Of Steam Water Piping In Fossil Fuel Power Plant	DLT 5366-2006
Technical specification for distributed control system in fossil fuel power plant	Q-DG 1-K401-2004
Code For Design Of Thermal Power Plant Steam Water Piping	DLT 5054-1996
Technical code for designing of thermal power plant air & flue gas duct/raw coal & pulverized coal piping	DL/T 5121-2000
Technical code for designing and calculation of pulverized coal preparation system of fossil-fired power plant	DL/T5145-2002
Code for designing insulation and painting of fossil fuel power plant	DL/T5072-2007
Design technical rule for selecting conductor and electrical equipment	DLT 5222-2005
Code for Designing Ash Handling System of Fossil Fuel Power Plant	DL/T 5142-2002
Technical rule of thermal power automation design for auxiliary system (shop) of fossil fuel power plant	DL / T 5227—2005
Technical Code for Designing Chemistry of Fossil-Fired Power Plants	DL/T5068-2006

SCOPE AND TERMINAL POINTS

Terminal Point Number	Description		Input/ Output	Details
1	Fuel Supply	coal	Input	Rail line of the site boundary.
		Diesel fuel	Input	Extend existing system to supply igniter fuel to the new boiler
2	Water	Potable water	Input	Two connecting points on existing potable water network
		Raw water	Input	Point on existing circuit to be defined on site
		Demineralized water	Input	Point on existing circuit to be defined on site
		Cooling water	Input	Point on existing circuit to be defined on site
		Cooling circuit blow down	Output	Existing blow down tanks
3	Ash	Bottom ash	Output	To provide a truck ash transportation system to ash storage area.
		Fly ash	Output	To provide a truck ash transportation system to ash storage area.
	FGD (OPTION)	Limestone	Input	Lime stone truck unload facility
		Gypsum	Output	To provide a truck transportation system to storage area.
4	Electricity		Input	At the busbars of 11 kV 1BBA and 1BCA existing switchboards for the feeding of the new boiler switchboard. At the existing 400V automatic transfer switching panel (1XKY01-GS002) for 400V emergency supply of the new boiler distribution panel At the existing 220/110V DC auxiliary sources panels for the DC supply of the new boiler distribution panel
6	Wastewater	Process effluents	Output	Existed process effluents treatment facilities

Terminal Point Number	Description		Input/ Output	Details
		Domestic effluents	Output	New drain channel
		Rain water	Output	Collecting system will include recycling facilities and overflow to new drain channel

GENERAL LAYOUT

Proposed site description

The power plant site is located near the town of Mahmud Kot, in the District of Muzaffargarh, Punjab Province. Islamic Republic of Pakistan. The site elevation is approximately 117 to 122 m above mean sea level (MSL). The owner is intended to replace its existing oil fired boiler (1 x 1200 ton/hr) with coal fired sub critical PC boiler.

Overall planning

The proposed project is to build 1 × 362MW coal-burning units to replace the existing oil fuel unit. The requirement to this project is that the existing oil fuel units will keep on running till new coal-burning units could be put into operation.

Existing switchyard is available for the new units.

The coal yard will be arranged in the north of the plant.

The railway will be arranged in the east of the plant.

The ash yard will be arranged in the northwest of the plant

The plant water source is river water and the backup water is groundwater.

Several buildings will be moved to other positions. The condition of underground structures is not clear, which requires owner to assist EPC contractor in all aspects.

General layout of the power plant

The new built retrofitting site contains 3 main parts. the main power building area, the dusting area, the coal yard area.

New Boiler will be erected on West side of the power plant (dismantling of HFO tank 2 to 4 in particular) .Coal bunker bay, boiler, are arranged from the east to the west. The central building and air compressor room are arranged near the boiler.

The dusting area is next to the boiler E.S.P, I.D FANS, chimney, absorbing tower are arranged from the east to the west. Fly ash silo, desulfurization complex building, emergency slurry tank, limestone storage shed are arranged at the north direction of the chimney.

The coal yard area will be located in the north of the plant. There are coal yard, weighbridge, coal contained wastewater treatment station, coal yard rainwater settling pond, coal yard spray water pond in this area. The coal will be transported to the coal bunker bay by the coal handing conveyer. The railway will be arranged on the eastern dam of the plant and the elevation of the dam is not clear at present. The local coal will be transported to the plant by the truck.

The workshop and ware house is arranged at the north direction of the boiler. Domestic sewage water treatment station, domestic and firefighting water pond, domestic and firefighting water pump house, water drainage pump house, rain water reclaimed treatment station are arranged at the south direction of the ash yard.

Some existing facilities need to be demolished or moved. The buildings and structures which are on the route of the coal handing conveyer will be demolished or moved. At present, the function of the buildings and structures is not clear. It could be demolished or moved whether or not will be verified by the owner.

Detailed arrangement of the units is shown as drawing F11151CB1-Z-01.

Railway and Road

Today, the power plant is not connected to railway. The existing railway lines and the two closest railways station (MahmootKot and Lal Pir Railway Stations) are located at about 1 to 2 km. The Owner will ensure the construction of a connection line from existingline up to power plant fence. The railway will be arranged in the east of the power plant.

Access to the site is a paved road off the D.G.Khan-Kot Addu Highway. For the roads in the plant area, some of the roads need to be demolished. If the existing roads need to be renewed, the width of the new road will follow the original width. If new roads need to be built, the width of main road will be 7m and the sub-road will be 4m. Most of the turning radius are 9.0m. Its surface will be cement concrete or asphalt pavement .

Fence

Temporary construction fencing will comprise a 2.5 m high chain link/mesh fencing supported by and secured to suitable fence posts at a maximum of 3.0 m centres and with provision for controlled access to the various contractors and work areas.

Pipelines arrangement

The steam pipe will be supported overhead. It will be from the new boiler to the existing steam turbine house.

MECHANICAL

Fuel

Coal

The fuel will be supplied by Employer from the South Africa Mine,

Table 4.1 Power Station Coal Typical Specification - DETAILED

NAME OF COMBUSTIBLE	KLEIN KOPJE	Range
Country	South Africa	
DIRECT ANALYSIS		
H2O	9	7 to 10
Ashes	14,01	10 to 15
Volatil matter	23,3	22.5 to 27
Fix carbon	53,69	See C in elementary analysis
TOTAL	100	100
ELEMENTARY ANALYSIS		
H2O	9	7 to 10
Ashes	14,01	10 to 15
C	64,79	63 to 66
H	3,55	3 to 4
S	0,55	0.15 to 0.7
N	1,55	1 to 3
O	5,55	5.5 to 6.5
Cl	0,01	0.00 to 0.02
CALORIFIC VALUE		
HCV on raw (kcal/kg)	6300	
LCV on raw (kcal/kg)	5954,3	
LCV on raw (MJ/kg)	24.93	23 to 25.5
LCV on raw (kWh/kg)	6.93	
ASH ANALYSIS		
SiO2 (A)	48,1	45.4 to 55.5
Al2O3 (A)	34,9	27.7 to 35
Fe2O3 (A)	3,4	5.3 to 2,7
CaO (B)	6,3	4.8 to 6.6
MgO (B)	0,6	0.6 to 2.3
Na2O (B)	0,1	0.1 to 0.3
K2O (B)	0,5	0.5 to 0.6
SO3	2,5	2.5 to 6.6
MnO	0	
P2O5	1,7	0.1 to 1.9
TiO2 (A)	1,7	1.5 to 1.7
TOTAL	99,8	
Hardgrove indice	55	45 to 55
ASH FUSIBILITY		
Atmospheric (Red. or Ox.) °C		
Regulation DIN ASTM		
EP IDT	1350	
HP ST		> 1 050°C
FP HT	1450	
FT	1460	

Diesel Oil

Startup fuel is HSD in present boiler and having below specs:

Start up Fuel Properties (HSD)

TEST	TEST METHOD	SPECIFICATION LIMIT
Specific gravity 60/60°F	ASTM D 1298	Max. 0.870
Distillation 90% recovery, °C (°F)	ASTM D 86	Max. 363 (685)
Colour ASTM	ASTM D 1500	Max. 2
Flash point (PMCC), °C(°F)	ASTM D 93	Min. 54 (130)
Sulphur content, % wt.	ASTM D 1551/1266	Max. 1.0
Copper strip corrosion 3 hrs at 50°C (122°F)	ASTM D 130	Max. 1
Viscosity Kinematic 37.8°C (100°F) cst	ASTM D 445	Min. 1.0 Max. 6.5
Cloud point, °C (°F)	ASTM D 97	Max. 6(43)
Pour point, °C (°F)	ASTM D 97	Max. 3(37)
Conradson carbon residue on 10% distillation residue, % wt.	ASTM D 189	Max. 0.2
Ash, % wt.	ASTM D 482	Max. 0.01
Sediment, % wt.	ASTM D 473	Max. 0.01
Water, % Vol	ASTM D 95	Max. 0.05
Cetane number or Centane index	ASTM D 613 ASTM D 976	Min. 45 Min. 45
Strong acid number mg KOH/g	ASTM D 3242	Nil.
Total acid number mg KOH/g	ASTM D 3242	Max. 0.5
Calorific value BTU/Lb	ASTM D 240	Min. 19000

Consumption of coal

Consumption of coal (BMCR condition)

Item	Unit	one boiler
		Design coal
Consumption of coal per hour	t/h	129.8
Consumption of coal per day	t/d	2596
Consumption of coal per year	t/a	713900

Note:

a、boiler equipment usage time is 5500h in one year

b、boiler average operating time is 20h per day.

Boiler

Boiler Proper

The boiler is of critical pressure, natural circulation, with drum and single reheat, balanced ventilation and tangentially firing at four corners.

The furnace surroundings are all welded membrane waterwall tubes. The division panel、SH platen and RH wall radiant are located in the upper of furnace. RH front platen is arranged in furnace outlet. SH finishing and RH finishing are in the horizontal gas duct. LTSH、LTSH PEND and Eco. are hanged in back pass. outdoor arrangement、two sides of horizontal gas duct、SH cavity and back pass surroundings are all membrane wall Two tri-section rotary air preheater are supported in boiler rear.

Boiler main parameter on MCR load

Boiler Design Code	As per GB
Builer Manufacture and inspection	As per GD
Superheated steam outlet flow	1185t/h
Superheated steam outlet pressure	17.5MPa.g

Superheated steam outlet temperature	541℃
Reheat steam outlet flow	978t/h
Reheat steam inlet pressure	4.052MPa.g
Reheat steam outlet pressure	3.856MPa.g
Reheat steam iniet temperature	337.8℃
Reheat steam outlet temperature	541℃
Feedwater temperature	283.3℃

Main design characteristic

(1) The boiler is single furnace, corners tangential firing burner, and with 5 mills. The max. tilt of burner is ±25°.

(2) The wall type radiation reheater and the big pitch division panel superheater are arranged in the upper furnace to increase the radiation characteristic of the reheater and the superheater, and to cut revolving gas flow and reduce gas temperature difference entering the convection heating surface along the furnace width. Wall type radiation reheater is arranged in front of water wall tubes on front wall and side walls. 4 pieces panel and 20 pieces of SH platen are arranged along the wide direction of furnace.

(3) The precise water circulating calculations have been done under every condition for each water wall circuit by computer, to guarantee the reliability of the water circulation. The membrane water wall adopts the form of welding the bare tube and fin.

(4) The position tube and hanging tube of steam cooling are used largely for all stages of super-heater and re-heater, to guarantee the reliability of operation. four groups of steam cooled localization clamp tubes are used along the width direction between the SH panel and the SH platen , the guidance positioning devices are used among the divided plate, SH platen and front water wall to make the localization and the clamp of the panel, prevent panel swing during operation; the steam cooled position tube crossed the furnace horizon between the SH platen and RH platen to guarantee transverse space between panels, and prevent swing during operation; LTSH in the back pass is hanged and posited by the water cooled hanging tube. For the high gas temperature area panel (SH panel, SH platen and RH platen), extend the inside tube coil to clamp the bottom tube of the panel.

(5) Lower gas speed is adopted at convection heating surface.

(6) Bigger transverse pitches are adopted on all stages of super-heater and re-heater, to prevent the slagging and ash plugging on the heating surface, and convenient for arranging crown-seal plate sealing device on the place where serpentine tube passing the ceiling, to improve the seal quality of the top of the furnace.

(7) The larger diameter tubes are used on all stages of super-heaters and re-heater, such as φ51, φ54,

φ57, φ63 and so on. Increasing the rigidity of the tube in manufacturing and the installation is advantageous in reducing resistance of super-heater and re-heater; it is advantageous in reducing gas side abrasion of pipes and improving abrasion resistance ability.

(8) Between the stages of super-heaters and re-heaters, single or little quantity of big diameter connecting pipes are adopted to connect, that might play the good mixer action to the steam, and eliminate the deviation. The larger caliber tees are used on the connected place between the header and the large diameter connecting pipe.

(9) Based on result of the wall temperature, the resistance and flow distribution calculated by computer, the material of every specifications in the super-heater and re-heater tube banks was selected; on the foundation of assuring the performance and intensity, all large diameter header and connecting pipes adopt the steel pipes of the GB code commonly used in boiler.

(10) The boiler is located outdoors, and the structure completely adopts the steel structure.

(11) The boiler is equipped with 2 ljungstrom air heaters, which have some excellence performance such as smaller site area, lower metal wastage and corrosion-resistant.

(12) There are Spring type safety valves at boiler drum, super-heater outlet pipeline and the re-heater inlet pipeline and outlet pipe line. There are two power control valves (PCV) at super-heater outlet pipeline to reduce the action of Spring safety valves.

(13) Steam temperature adjustment mode: the two-stages spray water is used for super-heater. The first is arranged SH between the low temperature super-heater and the SH panel. The second is arranged between the SH platen and final super-heater. The desuperheater is multi-hole tube type. The re-heater temperature adjustment mainly depends on the burner tilt, the change of exceed air is also useful for the temperature adjustment of super-heater and re-heater. The re-heater is equipped with urgency desuperheater, which is placed in the RH inlet pipeline and adopts atomize spray nozzle.

(14) Different kinds of sootblowers are arranged in the furnace, all stages of counter-flow heating surface and the air preheater, process control is used for the operation of the sootblowers, all wall sootblower and the extension sootblower should be operated every 2~4 hours according to the coal and ash condition of the heating surface.

(15) Besides calculating the intensity of boiler pressure components according to the ASME standard, the influence of intensity from the secondary stress is fully considered, the stress analysis to the main pipes and many special areas, to assure the reliability of operation.

(16) There is a expansion center used to precise thermal movement calculation, and used as the basis of expansion compensation, the gap reservation and the pipe stress analysis, and is advantageous to cooperate with stress situation of every pipe which is responsible with the DI. The design of boiler proper buckstay, the seal structure and the hanger bar are also considered. The expansion center plays an important role in assuring the boiler reliability operation and seal.

(17) Boiler buckstay is designed according to furnace design pressure ±5.8KPa, with a maximum instantaneous pressure ±8.7KPa. This design pressure is the furnace maximum instantaneous

negative pressure taking consideration of the urgent accident of the main fuel is shutoff, the FA fan is stop. This data conforms to the regulation of the National Fire Protection Association (NFPA). The first step of boiler horizontal buckstay arrangement is assure the maximum permission space through stress analysis as per every position gas side design pressure, span and pipe stress; the actual space of buckstay which is assured by the door hole arrangement should be smaller than this maximum permission space. Because the both sides span of boiler horizontal duct is the biggest, in order to reduce deflection, two vertical buckstay are arranged connected with the horizontal buckstay on each side.

(18) The start-up drain bypass with the capacity of 5% is equipped in boiler back pass lower header. Using the bypass for drain when boiler start-up to increase the speed of superheater temperature-rising. According to the experience, this small bypass with capacity of 5% may satisfy the request of cold & hot state start-up of the unit.

(19) The boiler is equipped with furnace supervision safeguard system (FSSS) which is used for boiler start-up & shutdown, emergency trip and auxiliary shut down and put into operation. Its major function is the furnace flame examination and the furnace safe guard. It also has important significance to prevent the furnace explosion and "internal explosion".

(20) There is the Distributed control system(DCS) for the unit, carries on coordination control between the steam turbine and boiler. It takes the boiler and the steam turbine as a complete system to execute boiler automatic control.

(21) The unit can operated as per not only fixed pressure operation but also sliding pressure operation. When the boiler operates and starts-up on low load, the sliding pressure operation is recommended, to obtain higher economy.

Boiler Auxiliary Equipment

Coal Pulverizing system

P&I diagram is shown on the F11151CB1-J02 .

According to coal ultimate analysis, the coal pulverizing system is of the direct fired pulverized fuel system. For Boiler, 5 sets of medium-speed pulverizer will be furnished, four for operation and one for standby. Boiler uses tangential firing. 5 sets of pulverizer outlet coal pulverized piping is connected with 5 floors of coal burner. According to the changing of boiler load, anyone pulverizer and corresponding burners can be stopped.

Boiler will be furnished with 5 sets of electronic gravimetric coal feeder, four for operation and one for standby.

Boiler will be furnished with two sets of fixed-speed, motor-driven, centrifugal primary air fan (P.A. Fan)

Boiler will be furnished with two sets of fixed-speed, motor-driven, moving vane adjustable axial flow forced draft fan (F.D. Fan) ,

Boiler will be furnished with two sets of fixed-speed, motor-driven, stationary vane adjustable axial flow induced draft fan（I.D. Fan）,

Boiler will be furnished with two sets of electrostatic precipitator.

Gas and air system is balance draft. Air pre-heater is tri-sector rotary regenerative type.

Assistant equipment selection of coal pulverizing system

Coal feeder

Boiler will be furnished with 5 sets of coal feeder before mill inlet, output 5~50t/h, when the pulverizer low load can the continuous running request. 4 coal feeder satisfy coal consume at BMCR condition. Each one allowable margin is not less then 10% of each pulverizer biggest computation output, the control precision ±0.5%.

Pulverizer

Boiler will be furnished with 5 medium-speed pulverizers. The 4 mills is satisfy coal consume at BMCR condition.

Pulverizer technical data table

NO	Item	Unit	Data
1	Model		
2	Coal consumption under BMCR	t/h	129.8
3	Quantity		5
4	Quantity in operation		4
5	output under BMCR condition	t/h	32.45
6	maximum output	t/h	40.242
7	flow under BMCR condition	t/h	52.737
8	sealing air flow	t/h	2.076
9	Desiccant temperature（BMCR）	℃	258
10	oulet temperature	℃	80

11	Coal particle size, R_{90}	%	17
12	Coal powder moisture at mill outlet	%	1.5
13	Resistance under BMCR condition	Pa	5840
14	Motor power	kW	315

Gas and air system

P&I diagram is shown on the the F11151CB1-J03\04.

Gas and air system is balance draft design. The air preheater is tri-sector rotary regenerative type, divides into primary air, second air and gas system three parts. The air preheater has the main driving alternating current motor and standby alternating current motor, and is equipped with the unit stop alarm system. Each air preheater is equipped with the thermo-element fire warning, the bearing oil temperature warning and the fire facility. The air preheater is equipped with the extension type soot blower and the washing water system, and has the installment which the air preheater overhaul needs. After air preheater operation, leaking air rate is less than 6%, operation for one year later is less than 8%.

1) Primary air system

This system main supplies hot air and cold air to mill and boiler burner. The system there are two 60% capacity Centrifugal P.A. fan, its import is equipped with the silencer. In order to cause a two air fans export wind pressure to be balanced, hot primary air duct and cold one primary air duct all have header.

The flow of P.A. fans includes primary air capacity when boiler maximum continual rating, pulverizers and coal feeders sealing air capacity.

Margin of head 30%

Margin of flow 25%

P.A.F data table:

No.	ITEM	UNIT	DATA (BMCR)	DATA (TB)

No.	ITEM	UNIT	DATA (BMCR)	DATA (TB)
1	Volume flow	m3/s	48.62	61.88
2	Air temperature	℃	27	37
3	Total Resistance(via pressure revise)	Pa	11810	15353
4	Fan quantity	set	2	2

2) Second air system

This system supplies needed combustion air for boiler. It has two 60% capacity the moving blade adjustable axial-flow fans with inlet silencer. In order to cause two fan outlet air pressure balanced and nimbleness operation, contacting air duct will be equipped after the fan outlet dampers. In order to cause hot second air pressure balanced, contacting air duct will be equipped after preheater outlet dampers.

The flow of F.D. fans includes second air capacity and combustion capacity when boiler maximum continual rating.

Margin of head 15%

Margin of flow 5%

F.D.F data table

No	ITEM	UNIT	DATA (BMCR)	DATA (TB)
1	Volume flow	m3/s	121.8	130.2
2	Air temperature	℃	27	37
3	Total Resistance(via pressure	Pa	3688	4325

No.	ITEM	UNIT	DATA (BMCR)	DATA (TB)
	revise)			
4	Fan quantity	set	2	2

3) Flame scan cooling air system

The flame scan cooling air system supplies two flame scan cooling air fans, provides the cooling air for the flame scan probe head.

4) Gas system

This system extracts gas from the chamber, through the rear part heating surface, the air preheater, the electrostatic precipitator the chimney to the atmosphere. Plant will set up FGD system. There are inlet and outlet of FGD at the flue gas total duct in front of chimney. After the electrostatic precipitator, it is equipped with two 60% capacity stationary vane adjustable axial flow I.D. fan.

Margin of head 20%

Margin of flow 10%

I.D.F data table

No	ITEM	UNIT	DATA (BMCR)	DATA (TB)
1	Volume flow	m^3/s	273	312
2	Air temperature	℃	131.7	141.7
3	Total Resistance(via pressure revise)	Pa	5158	6190
4	Fan quantity	set	2	2

Sealing air system

This system supplies the pulverizers and coal feeders sealing air. Boiler is furnished with two 100% capacity sealing air fans, one for operation, one for standby.

Chimney

The flue gas of boiler come in a chimney, the chimney height is 210 meters, steel channel with diameter is 5.5 meters.

Main Building Arrangement

Principle of Main Building Arrangement

Main building of this phase project is arranged according to 1X362MW scale.

Main building arrangement drawing is shown on F11151CB1-J07/08.

Major Dimensions of Main Building

Major Dimensions table of Main Building

No.	Item	value（unit：m）
Coal bay	Span	11.000
	Total length	54
	Coal feeder floor elevation	EL+12.600
	Belt floor elevation	EL+31.500
	The top beam bottom elevation	~EL+71.970
Boiler house	Operating floor elevation	EL+12.600
	Boiler front span	6.500
	Boiler width	14.048
	Boiler depth	14.019
Coal bay B row of column center line to chimney center line spacing		143.100

No.	Item	value（unit：m）
Chimney export elevation		210.000

Coal bay arrangement

4.4.3.1 The coal bay is arranged behind boiler, divided into ±0.000m, 12.600m, 31.500m three floors.

4.4.3.2 5 medium-speed pulverizers are arranged in the first floor. The channel in B row of side is used for installation and overhaul.

4.4.3.3 The gravimetric feeder with electronic weighing will be arranged on the operating floor corresponding to the place of medium-speed coal pulverizer. The bunker will be arranged from 31.5m level to 17m level before the feeder. It's effective volume will be 541m^3. It can meet the requirement of boiler firing coal for about 12 hours at BMCR load. The coal bunker will be metal structure..

Boiler area arrangement

4.4.4.1 The boiler is the outdoor, uses the island type arrangement, in the boiler steel frame scope revolves the level platform (12.600 meters levels) is the steeliness big platform, each platform needs to establish according to the equipment running attention. Boiler is furnished with 1 elevator to carry both passengers and cargo, with the anchors floor in the boiler proper main platform level. The light section room lid is furnished at the top of furnace.

4.4.4.2 There are 2 sets of F.D.F, 2 sets of P.A.F in the fans room behind the boiler. There are a water washing tank and water washing pump out the fans room for boiler .

4.4.4.3 2 sets electrostatic precipitator and 2 sets of I.D.F are arranged behind the air preheater in turn. I.D.fans are arranged in the outdoor. The gas duct uses the steel structure.

4.4.4.4 A double inner liner chimney will be arranged behind I.D.F room.

Hoisting Facilities for Installation and Maintenance

4.4.5.1 Overhead crane will be established above the mills.

4.4.5.2 The special-purpose single track hoists will be established above the blades and motors of Fans.

Closed Cycle Cooling Water System

Auxiliary equipments of boiler will be cooled by closed cycle cooling water. The closed cooling water system (CCCW) heat exchanger will be cooled by open cycle cooling water. The secondary water source comes from demineralized water.

The closed cycle cooling water system will comprises of two cooling water pumps (one working and one standby), two 100% demineralized water/circulating water heat exchangers, one expansion water tank. Expansion water tank will located on high position, which can assure system to be stable pressure and accommodate system thermal expansion effects, and also could to be used for the system water filling and water make-up.

The open cycle cooling water system will comprises of one electric water strainer, the sources water is mine groundwater.

Compress air system

There are 4 sets of water cooled, micro-oil, rotary screw type complete with driven motors, air compressors, pressure is 0.85MPa.g and 4 sets of micro-heat compressed air post treatment device in the air compressor house, one set is for instrument air system and service air system, one set is for ash handling, other 2 sets are standby. There are 1 set of instrument air tank , 1 set service air tank and 2 sets of air tank for ash handling out the air compressor house.

The compressed air systems refer to: F11151CB1-J05

Thermal Insulation

General

In order to guarantee the heat efficiency of the power plant, a good working environment and the performance of the equipment and piping, the equipment and pipe will be thermal insulated to reach the purpose of saving energy, personnel protection, freeze protection, dew-proof and noise elimination

Technical requirements

The equipment and pipe will be thermal insulated when their surface temperature is higher than 50℃. If the environment temperature is lower than 27℃, the outside surface temperature of equipment and piping will not be more than 50℃. If the environment temperature is higher than 27℃, the outside surface temperature of equipment and piping will be higher 25℃ than the environment temperature

Heat insulating layer material:

The insulation material shall be composite material of aluminum silicate and rock wool. rock wool and aluminum silicate fibrous rope in this subject. The insulation material shall be designed according to following principle

1)Composite material of aluminum silicate and rock wool will be used for the pipes which outer diameter is bigger 38mm and equipments in which the fluid temperature is 350℃ or higher than 350℃.

2) The rock wool will be adopted for all pipes and equipments with fluid temperature below 350℃.

3) Removable valve casing will be used for valves insulation;

4) The pipes which outer diameter is below 38mm will be insulated by aluminum silicate fibrous rope.

4.7.4 Insulation cladding material:

Galvanized iron sheet will be used in this plant. For indoor, thickness of galvanized iron sheet is 0.5 mm. For outdoor thickness of galvanized iron sheet is 0.7 mm. For the big section rectangular air duct, 1mm shaped galvanized iron sheet will be used.

CHEMICAL WATER TREATMENT

General

The scope of chemical water treatment plant contains: chemical dosing system, sampling system, wastewater treatment system (include sanitary waste water treatment system, coal waste water treatment system, desulfurization waste water treatment system), rain water recovery treatment system, laboratory for coal analysis etc..

Remark: The project only replace the boiler (from oil fired to coal fired), and the make-up water treatment system, the condensate polishing system, the circulating cooling water treatment system, the hydrogen generator system and the chemical laboratory will be used the existing facility. For the waste water treatment system, the exiting industrial waste water treatment system will be used, but new sanitary waste water treatment system will be supplied since there will have new building.

Boiler make up water treatment system

The existing make up water treatment system will supply DM. water to new boiler and other auxiliary system which need DM water.

REMARK:

Existing demineralised water net work will be extended if necessary;

Chemical Dosing System

The system of chemicals will consist in:

Phosphate injection in boiler;

Oxygen scavenger in feed water

Steam and condensate PH correction

All the products will comply with the steam quality required for seam turbine

For each unit and each product to be injected, a skid including a storage tank, transfer pumps to dilution tank when required, demineralised water make up when required, diluted reactive tank, transfer pumps and piping connection with all need valves and instrument will be supplied.

Redundancy for any equipment necessary to continuous injection will be provided.

Safety shower and eye washing, operated by foot treadle will be installed adjacent to chemical unloading points and dilution systems. Such showers will avoid thermal shock to personal. Operation of any shower will raise a visual and audible alarm both locally and within the control room.

Please see the drawing F11151CB1-H-01 for detail information. The chemical dosing equipment will be located at the zero meter of the building.

Sampling system

An automatic, continuous and periodic sampling system for the feed water, steam and condensates at precise locations on the thermal cycle (including auxiliary steam system and make up system)

The sampling points and corresponding detectors will be positioned to obtain samples representative in all operating conditions.

Each sampling point for analysis in automatic mode will also be associated with a manual sampling point.

Manual sampling will not interrupt automatic mode sampling.

If necessary, the samples will be brought to a temperature enabling the analysis instruments to operate correctly using closed-cycle cooling water. The analyzers should in any event be protected against excessive temperatures (including cooling failures) and the temperatures of each sample recorded and indicated locally.

All the sampling lines will be transferred on a rack on which the automatic mode analysis instruments and all the connected devices will be mounted. This sampling system rack will be installed in a safe position allowing easy access under all conditions.

All remote measurements will have a corresponding local indicator, whether it is an integral part of the analyzer or an indicator to be mounted adjacent to the analyzer.

All automatic analysis results, sampling system faults and alarms will be transferred to the main control room.

The sampling points on the basis of the cycle configuration and the operation conditions will be determined

All necessary equipment to monitor the chemistry of the condensate, feed water, boiler water, saturated steam and superheated steam will be supplied. All routine chemical control parameters will be monitored by means of on-line monitors, with appropriate indications and alarms relayed to the main control room. A minimum requirement for continuous on-line monitoring will be:

Condensate from condenser: pH, total conductivity, cationic conductivity

Demineralised water: pH, conductivity

Feed water: pH, conductivity, dissolved O_2

Boiler water: pH, conductivity

Boiler saturated steam: pH, total conductivity, cationic conductivity, silica

Boiler superheated steam: pH, total conductivity, cationic conductivity, silica

All necessary stream/water circuit sample points, pipe work, isolation valves, sample coolers, filters and pressure regulating and sampling valves appropriate to the pressure rating of the sample points

These sample line will also be connected up to existing lab facility, routing from sampling rack

Please see the drawing F11151CB1-H-02 for detail information. The sampling equipment will be located at the operation floor of the control building.

Industrial waste water treatment system

The industrial wastewater treatment plant will be designed to collect and treat waste water from power station processes or other site sources such as: power Station drain, ground flush water and other drains.

Considering the plant has been set the industrial waste water treatment plant, so the industrial waste water produced by this project will be connected to the existing industrial waste water treatment system.

Sanitary waste water treatment system

Sanitary waster water for the project mainly includes employees' bathing and washing drainage water, toilet drainage water and so on. The total tonnage of sewage water will be $3m^3/h$. The main pollution factors in sanitary waster water will be COD, BOD_5, SS and oil.

A completely sanitary waste water treatment system will be provided to treat the sanitary waste water form the new boiler plant and auxiliary building.

Coal waste water treatment system

The coal waste water will first flow into the coal waste water settling basin, after being subsided, the coal waste water will be pumped to the utility pure water preparation and filtrated. The clean water will be pumped to coal wash basin as coal handing make-up water.

A completely coal waste water treatment system will be provided to treat the coal waste water from the coal yard and coal handing washing water.

Laboratory for coal analysis

The laboratory for coal analysis will be supplied. The laboratory will consist in:

Coal sampling room;

Balance room,

Heat metering room;

Element analysis room;

Analysis room,

Office room;

Store room.

COAL HANDLING

Design Scope

The design scope of coal handling system will be from the unloading facilities to the coal bunkers in boiler house

Design Precondition

Assuming the size of the coal supplied from the international or local is less than 300mm.

The coal will be delivered to the power plant by wagons and trucks. The wagons and trucks will be provided by owner. The wagon unloading size will be modified with the type and parameter of wagons.

Coal Consumption

The coal consumption of one boiler for design coal is listed as following:

Unit capacity	Hourly coal consumption(t)	Daily coal consumption(t)
362MW	129.8	2596

Note: In which daily operation time of unit will be 20 hours.

Coal Handling System Description

The purpose of the coal handling system will be able to receive coal from unloading facilities and transport the coal to the boiler bunkers. Dual way belt conveyor except C-2、C-10A、C-10B、C-11 will be provided

Unloading System

In wagon unloading a coal shed will be provided, and two paddle feeders will be provided to discharge coal from wagon unloading to belt conveyor C-1AB. Coal will be delivered to T-2 transfer tower by C-1AB and C-2 belt conveyor. In T-2 transfer tower, coal will be transferred to international circular coal storage yard by belt conveyor C-8A/B and circular stacker or transferred to local circular coal storage yard by belt conveyor C-3AB, C-10A and circular stacker or directly to boiler house by supplying conveyors

In truck unloading hopper a coal shed will be provided, and two vibrating feeders will be provided to discharge coal from truck unloading hopper to belt conveyor C-11. Coal will be delivered to T-3 transfer tower by C-11 belt conveyor. In T-3 transfer tower, coal will be transferred to local circular coal storage yard by conveyor C-10A and circular stacker.

Coal Storage Yard and Coal Yard Equipment

Two international circular coal yards will be provided. The storage capacity of each circular coal yards will be about 75000Tons

One local circular coal yard will be provided. The storage capacity of circular coal yard will be about 50000Tons.

One circular stacker/reclaimer will be equipped on each circular coal yards for stacking and reclaiming. Under each circular coal yard, two uncoalers will be provided, one operation, one standby.

Bulldozers will be supplied for auxiliary work. A bulldozer garage will be provided with water recycling.

Supplying System

The coal will be transferred to crusher house by belt conveyors C-4AB.In crusher house, 2 sets of screens, 2 sets of ring-type crushers will be provided. Coal will be crushed from size of less than 300mm to less than 30mm.

The coal will be transferred to bunker bay by belt conveyors C-5AB, C-6AB, C-7AB. On bunker floor, conveyor C-7AB and plow dischargers will be installed for coal distribution.

Coal Blending

Local coal can be blended with international coal with a target of 10 to 20%.

It is direct feeding of international coal form unloading hopper or international coal storage yard and reclaiming local coal from local coal storage yard.

Auxiliary Equipment

All auxiliary equipment for a complete and operable system will be provided.

Including magnetic separators, belt scales, test-chain calibrator, coal sampling equipment, metal detector, varia removal machine, hoisting and maintenance equipments etc.

Auxiliary Building

The following auxiliary building will be provided in coal handling system:

Coal handling system control building

Bulldozer garage

ASH HANDLING

According to the concrete conditions of the project, the fly ash shall be conveyed to fly ash silo by pneumatic conveying method. The bottom ash shall be transported by submerged scraper conveyor(SSC) to bottom ash silo to store. Both fly ash and bottom ash shall be transported to ash yard or ash users by trucks.

According to the requirements of the tender,There are two types of dust discharge program.

The first program:dust discharge≤500mg/Nm³.

It will be equipped two Electrostatic Precipitators with double chambers three fields for this project The efficiency is not less than 96.8% temporarily.

The second program:dust discharge≤50mg/Nm³.

It will be equipped two Electrostatic Precipitators with double chambers five fields for this project The efficiency is not less than 99.71% temporarily.

Discharge quantity of fly ash and bottom ash

The quantity of ash refers to following table :

Coal	Program	Unit	1X362MW
Design coal	Ash	t/h	18.20
	Bottom ash	t/h	2.73
	Fly ash	t/h	15.47

Note. 1. The ratio of fly ash quantity and bottom ash's is temporarily considered as 85% and 15%;

Bottom ash handling system

One submerged scraper conveyor (SSC) will be equipped for Boiler. The bottom ash shall be cooled by water and conveyed to the bottom ash silo by submerged scraper conveyor (SSC), and then bottom ash drops into bottom ash silo for storage and concentration. Finally the bottom ash will be transported from bottom ash silo to ash yard by special trucks.

The capacity of the submerged scraper conveyor system is 11t/h, it should meet 400% bottom ash quantity which is produced on BMCR condition burning design coal.

One bottom ash silo will be equiped. The bottom ash silos adopt steel structure style. The bottom ash silo shall be capable of storing all the bottom ash produced by one boiler on BMCR condition for not less than 48 hours when burning design coal.

There are only one discharge outlets at the bottom of bottom ash silo. The outlet will be equipped pneumatic slide valve, and the humidified bottom ash is transported to ash yard by trucks.

Fly ash handling system

The poject matches 1 set of positive dense phase pneumatic conveyance system. The system will be equipped under the electrostatic precipitators. The fly ash from the Electrostatic Precipitator hoppers shall drop into the ash transportation equipments and then be transported to the fly ash silos through pipes. The capacity of each set positive dense phase pneumatic conveyance system should meet the fly ash quantity can meet 150% fly ash quantity which is produced on BMCR condition burning design coal.

There will be 2 fly ash silos in the whole plant, which adopt steel structure, 2 fly ash silos total capacity is 8000t, it will be the capable of storing the fly ash produced by one boiler on BMCR condition about 480 hours when burning design coal.

There are four discharge outlets at the bottom of each fly ash silo. Two of them will be equipped humidifying device (one run and one standby) to discharge wet fly ash (about 25% water), and the humidified fly ash is transported to ash yard by dump trucks (the trucks will be considered by owner); the other two outlets will be equipped dry ash unloader (one run and one standby) , and the dry ash will be transported to users by tank trucks.

Mixing water system

The mixing water pumps installed under the fly ash silos, it will supply water for fly ash silos and bottom ash silos discharging wet fly ash. The water supplied must satisfy the discharging of both the fly ash silos at the same time.

Air Compressor System

The conveying air supplied for fly ash handling system will be produced by the air compressor house for the whole plant.

Fluidizing air system

For discharging the fly ash successfully, there will be fluidizing devices at the bottom of each fly ash silo and the ESP hoppers. The fluidizing air will be provided by the fluidizing air blowers.

Ash Handling System to off-site

Both fly ash and bottom ash shall be transported to ash yard or ash users by trucks.

ELECTRICAL

Loads change

Each part (11 KV) will load minus the original boiler system .New load including new coal boiler system load, load of a coal conveying system, the electric system load. After load increase, unit 11 KV 1A section increase 11877 KVA, 1B section increase of 9594 KVA. Consider of HV auxiliary transformer capacity can meet the requirements.

Auxiliary and Standby transformer

Auxiliary transformer

This unit consists of a HV auxiliary transformer 44 MVA ONDF 220/11 KV. HV auxiliary transformer two 11 KV power bus, and two new system will be connected to the bus on average. The new system, dust removal system, coal boiler system, lighting and communication system.

Standby transformer

Thic unit consists of a stand by transformer 44 MVA 220 ± 10%/11 KV ONDF. The new HV auxiliary transformer two 11 KV power bus, and new system will be connected to the bus on average. New systems are including the boiler system, dust removal system, coal systems, lighting and communication system.

Auxiliary and Standby power system

MV auxiliary power system

Two new 11 KV system will provide power supply load respectively, new boiler will be connected to the original 11 KV 1 A-and 1 B. The unit will have two new 11 KV bus for the HV auxiliary transformer, and the new loads will be connected to the new buses for coal conveying system, The new 11 KV respectively connected to the original on the 11 KV.

MV Standby power system

Each bus under the standby transformer of 11 KV respectively will connect the new 11KV boiler bus and 11 KV coal bus.

LV auxiliary power system

The unit will increase two boiler transformers, three E.S.P transformers, and one coal transformer. LV auxiliary power system will be PC-MCC, solid grounding type. LV transformers will be standby for each other. Existed 1700kW diesel generator set will supply emergency power for the EMERGENCY SERVICE UNIT.

Primary electrical equipments

MV auxiliary power system will use VCB; short circuit level will be 50kA. LV auxiliary power system short circuit level will be 50kA.

Primary electrical equipments layout

11KV and unit LV distribution will be located in main building A-B column. LV distribution of the plant will be in auxiliary workshops.

The desulfurization system (Option)

If increasing the desulfurization system, the unit increase two Circulating Slurry pump(420kW and 470kW), Forced Drift Fan capacity from 2560 kW to 3070 kW. the desulfurization of low pressure will be for 3 units of 2000 kVA transformer capacity change into 3 units of 2500 kVA.

Essential Service AC and DC Systems

System Description and Scope

The essential-service ac and dc system consists of two subsystems, essential-service ac, and essential-service dc

The essential-service ac subsystem provides low-volt ac, single-phase, 50-hertz power to essential control, instrumentation, and equipment loads that require uninterruptible ac power.

The essential-service dc subsystem provides a reliable source of power for the essential-service ac subsystem and critical control and power functions during normal and emergency plant operating conditions.

Batteries

The Contractor will provide an ungrounded DC system consisting of one battery per unit common station unit. The batteries will be sized to handle the duty cycles determined in the final design Batteries must be able to supply full projected load for no less than 1 hour after loss of charging system

Each battery will be sized with the assumption that all switchgear breakers will be operated at the end of the one-hour period

The battery cells shall be the lead-acid type with pasted plate grids contained in transparent plastic jars.

Protective devices in DC distribution panels will have an interrupting capacity greater than the maximum available short circuit current and Contractor will verify that the interrupting devices are DC rated for the maximum available fault current. All cables and the DC distribution system will be designed to withstand the maximum available short circuit current.

Battery Chargers

Contractor shall design, manufacture, test, deliver, and erect battery chargers, two for each battery.

Uninterruptible Power Supply

Contractor will design, fabricate, test, deliver and install 50 kVA UPS as specified hereinafter. The exact size of the UPS shall be determined by the Contractor.

The UPS will be used to provide continuous power to essential loads and sensitive electronic equipment during normal operation and voltage disturbances.

Output Rating of UPS System: The output of the UPS System(s) shall be 50 kVA, single phase, two-wire, and 0.8 lagging PF.

Static Transfer Switch

The static switch shall be single-pole and double-throw. The switch shall be capable of carrying the continuous, short time (overload) and short circuit specified for the UPS system.

The switch shall be used for automatic transfer between the synchronized static inverter and the alternate ac supply. The switching shall be done with silicon-controlled thyristor

AC Distribution Panel board

One panel board, 220 V single-phase, two-wire, with main breaker and neutral buses shall be furnished.

The distribution panel shall be factory wired to other related equipment. The buses and interconnections shall be suitable for carrying full inverter output without exceeding 65°C rise.

Lighting and maintenance system

Lighting system will consist of normal AC lighting system, normal /emergency (N/E) AC lighting system and emergency DC lighting system.

Voltage and power source for lighting and Maintenance system

Voltage

(1) Normal AC lighting system power will be supplied by 400/230V bus sections;

(2) Normal/ Emergency AC lighting system power will be supplied by 400/230V bus sections;

(3) Emergency DC lighting system power will be supplied by DC 220V bus sections;

(4) The voltage of the portable lighting fixture will be 24V;

(5) The voltage of the portable lighting fixture for boiler area will be 12V.

Power sources

Power sources for normal AC lighting system

(1) Normal AC lighting will be supplied by nearby distribution board

Power sources for N/E Lighting system

(1) Emergency DC lighting of control room and diesel generators room will be supplied by AC-DC switch panel.

(2) Normal/ Emergency AC lighting will be supplied by N/E MCC section .The load of Normal/ Emergency AC lighting is about 10～15% of the whole plant load ,and the load of unit cnntrol room is about 30% of the whole plant load.

(3) Emergency lamp will be used for important workshops outside the main building as emergency lighting. Emergency lighting will be provided by self-contained battery lighting fixture assemblies.

Maintenance system

(1) Maintenance power source will be supplied by nearby distribution board.

Normal lighting power network

Normal lighting use 400/230V three-phase four-wire which the neutral point grounding directly system. Grounding type of lighting network will use the TN-CS system.

In order to guarantee the quality of the voltage of the lighting network, the main plant supplies power for lighting and power separately.

Luminous source and lighting fixture

Luminous source

Long life and high light efficiency luminous source will be provided, such as high pressure sodium lamps, metal halide lamps and fluorescent lamps. Incandescent lamp or energy-saving lamps will be used for Emergency DC lighting system.

Lighting fixture

(1) In the offices, conference room, laboratories, rest room and electrical equipment room, high efficiency fluorescent type fixture will be used. Control room area lighting will be provided by using recessed aluminum alloy louvered type fluorescent fixtures. Other indoor areas will use waterproof dustproof and corrosion-proof lighting fixtures and the others factory lighting fixtures according to the task.

(2) In the outdoor areas, waterproof dustproof and corrosion-proof lighting fixtures and projector lighting fixtures will be used according to the task.

(3) Air-craft lighting fixture will be used in chimney area and High-rise buildings.

(4) The risk of explosion area's lighting takes explosion-proof measures.

Lighting Control

Electric power to light fixtures located indoors will be switched with wall mounted light switches or lighting distribution box.

Electric power to light fixtures located outdoors will be switched with photo-electricity controllers or time switch.

THE INNER COMMUNICATION

The inner communications is one of power plant public system, mainly consist of administration communication system, dispatching communication system, (including coal handling public address / intercom system, wireless communication systems) and communication network.

Administration Communication System

Administration communication system of the Power Plant will be connected to the telecom network

Dispatching Communication System

Dispatching system equipped with a set of coal handling system, equipped with a set of coal handling public address / intercom system, and configures 30 Paging station. The coal handling public address / intercom system configure with the expansion of capacity.

Configure 30 radio interphone in the auxiliary production posts which are far from the main power plant to solve maintenance、debugging staff's communication and mobile staff's communication problems.

Arrange

The host and main console of coal handling public address / intercom system install in the coal handling control room.

I&C

General

Design Scope

The automation system necessary for the I&C of the new boiler and its auxiliaries (including BPS, BMS, ESD, ash handling, coal handling systems, FGD, ESP, compressed air plant, SWAS, HVAC etc.). Coal handling system & ESP, details see electrical part.

Supply Scope

In design scope of above-mention the instruments and control systems will be supplied, including NEW DCS system, PLC system, local measuring instruments, actuators, instrument valves, control panels, consoles, cabinets, junction boxes, cables, cable tray and installation material etc.

STANDARDS AND CODES

The Instrumentation and Control systems will comply with KKS code and all relevant International Standards and in particular with the following reference standards:

Reference Abbreviation		Name and Address
	NFPA	National Fire Protection Association
	ASME	American Society of Mechanical
	ANSI	American National Standard Institute
	IEC	International Electrochemical Commission
	DL 5000-2000	Technical Code For Designing Fossil Fuel Power Plants
	DL/T 5175-2003	Technical rule for designing thermodynamic control system of fossil fuel power plant
	DL/T 5227-2005	Technical rule of thermal power automation design for auxiliary system (shop) of fossil fuel power plant
	DL/T 5182-2004	Technical rule for designing of local equipment installation, pipeline and cables of I&C in power plant
	Q/DG 1-K401-2004	Technical specification for distributed control system in fossil fuel power plant

I&C Automation Level

One set of DCS for the unit will be adopted for the new boiler and its auxiliary system. The new DCS system Link to the existing DCS is ensured by a Gateway or other communication interface.

The DCS system will perform the functions of monitoring, control, alarm, protection and interlock, diagnosing, accident treatment and maintenance guidance of the boiler to meet all requirements at various operation conditions, to assure safe and economic operation of the unit.

The new boiler operator station will be arranged in exiting control room. Flue Gas Desulphurization system (FGD) of the unit will be monitored and controlled in existing control room and FGD control room.

The operators in control room can complete the following control functions:

- Unit start-up /shut-down control;

- supervise and control unit during normal operation;

- Complete emergency handling under unit abnormal operation;

All required monitoring and control functions, including unit start-up, shut-down and normal operation will be attained through LCD, keyboard, mouse. Emergency hardwired trip push button (ESD)for boiler, the hardwired run/stop push button for the important equipment etc. will be designed on the control desk, which will ensure unit shutdown safely under emergency operation.

The Auxiliary system (such as Ash handling system, SWAS, and HVAC) will be controlled through Microprocessor-based Programmable Logic Controllers (PLC). Control and monitor function will be complete through local operator station located in local control room or local electronic room. The important signals can be communicated to the new DCS system.

Flue Gas Desulphurization system (FGD) of the unit will be monitored and controlled by DCS system The operator stations and engineering station of FGD DCS will be located in the local FGD control room, the cabinets of FGD DCS will be located in the local FGD electronic equipment room. The FGD DCS can be communicated with the Auxiliary System Process Information Network by data link

Layout for equipment complex building

One equipment complex building will be designed near the new boiler house The building will be separated into five floors: 0m level, 6.0m level, 9.8m level, 12.6m level and 18.6m level.

The equipment complex building at 12.6m floor include engineer station room, electronic equipment room, sampling room, I&C maintenance room and relay room etc..

DCS control desks of the boiler, CCTV monitor, drum level monitors and furnace flame monitors will be arranged in the existing central control room.

Boiler DCS cabinets, Flame scanner cabinet, soot-blower cabinets and power supply cabinets will be arranged in electronic equipment room. For detail arrangements refer to drawing No. F11151CB1-K-05.

The Central Control Building at 9.8m floor is cable mezzanine, this floor is convenient for all electric and I&C cable routing.

The equipment complex building at 6.0m floor includes electrical switch room, accumulator room and ventilator room etc. For detail arrangements refer to drawing No, F11151CB1-K-03

The equipment complex building at 0m floor include chemical dosing room, switch room, ventilator room and central refrigerating station etc.. For detail arrangements refer to drawing No, F11151CB1-K-02.

The equipments of air conditioning system will be arranged at floor 17.6m.

I&C Function

DCS Control Function

The Distributed Control System (DCS) will be adopted for the new boiler and its auxiliary system. The DCS will implement the following functions: Data Acquisition System (DAS), Modulating Control System (MCS), Sequence Control system (SCS), Boiler protection System (BPS) and Burner Management System (BMS) etc.

1) Data Acquisition System (DAS)

The DAS is a part of the DCS. DAS system receives process operating parameter signals, equipment status signals and some signals from other control systems, after conditioning, calculating for these signals, provide operator with operating information and operating guidance to ensure the unit operating safely and economically. Main functions for DAS are as following:

a. Input signal conditioning

b. Alarm limit check and over-limit alarm

c. Displays, including operation display, process mimic diagram, group displays, bar graphic displays, trending displays and alarm displays, etc.

d. List log, it includes periodical log, Sequence of Events (SOE), trip log, etc.

e. Historical data storage and retrieve

f. Basic operating guidance etc.

2) Modulating Control System (MCS)

The MCS is a part of the DCS. MCS system includes some closed analogue regulating loops. MCS will be designed to control automatically the unit load, some important process parameters(PV) (temperature, pressure and level, etc.) to set-point value(SV) to ensure unit safe and economical operating. Manual mode will be designed for MCS, when the bias between PV and SV is high than preset value or other abnormal conditions occur, auto mode will be changed-over to manual mode. Auto tracing function will be designed for MCS, in manual mode, auto tracing will be realized automatically according to feed-back signal. When essential conditions are met, auto mode will be put in without interfere.

3) Coordination control system (CCS)

CCS system will be designed for the unit. The output of boiler, turbine will be coordinated controlled according to Load Dispatch Centre (LDC) to ensure rapid response to LDC load command and unit steady operation. Other control modes will also be designed for reasonable operating according to unit's condition. Auto change-over between different control modes will be realized without interfere. Following control mode will be designed for CCS:

a. Manual control mode

b. Boiler follow control mode

c. Turbine follow control mode

d. Coordination control mode

Besides CCS System, following closed control loops will be designed:

a. Boiler master control

b. Boiler drum level and feed-water control

c. SH steam temperature control

d. RH steam temperature control

e. Furnace pressure control

f. Coal feeding flow control

g. Pulverizer control

h. Primary air flow control

i. Secondary air flow control

j. Secondary air pressure control

k. HP Heater Level Control etc.

4) Sequence Control system (SCS)

The SCS is a part of the DCS which is composed of some function groups defined according to process system and auxiliary equipments requirement. Each function group will perform sequent startup / shutdown, open / close of motors, pumps, dampers, valve, etc. and corresponding interlock and protection function in accordance with unit operating requirement. SCS includes following function groups:

a. Forced draft fan function group

b. Induced draft fan function group

c. Primary air function group

d. Coal feeder/Pulverizer function group

e. Combustion function group

f. Feed water pump function group

g HP heater function group,etc.

5) Boiler Protection System (BPS)

The design of the boiler protection system (BPS) shall comply with the NFPA 85 standard.

It shall be possible to operate and keep the boiler in service with its protection system operational if supplementary firing equipment is switched off and/or out of service. A trip of fuel oil burners initiated by the Burner Management System shall not trip the boiler and shall not cause a loss of the boiler protection totally or partially.

The criteria to be considered in the design of the BPS will be defined by the boiler manufacturer during the engineering stage.

6) Burner Management System (BMS)

The BMS is a part of the DCS. The BMS will be designed to realize the startup / shutdown, interlock and protection of boiler and its auxiliary system (igniters, burners, coal feeders, etc.). The BMS will be complied with NFPA 85 standard. The BMS will perform the following functions:

a. Furnace Purging

b. Boiler igniting

c. Flame monitoring and interlocking for the startup of burners.

d. coal pulverizing system management

e. Master Fuel Trip (MFT)

f. Other control function associated with the boiler

Boiler Soot-blowing Control System

The Boiler Soot-blowing Control system will be performed in DCS.

The soot-blowing control system will perform the following functions:

Sootblowers will be sequence controlled;

Manual initiation of automatic cycle;

Manual blow of any selected sootblower;

Blowing failure alarm;

Forward and reverse travel indication for long retractable sootblowers;

Automatic retract of sootblowers upon motor overload,

Condensate draining system based on temperature indication.

Closed Circuit Television System (CCTV)

The new CCTV system will be designed for the new boiler and its auxiliary system, It will reserve communicated interface or other interface with the existing CCTV system.

Supervision scope of the CCTV will include the following areas:

a. Railway access

b. Train unloading station

c. Coal yard

d. Ash truck loading

e. Limestone delivery station

f. Gypsum truck station

g. Gypsum dehydrating station

h. New boiler building

i. Fuel oil system area

Monitors will be layout:

a. In coal handling control room & ash handling control room,

b. unit control room

Auxiliary Control System

The Auxiliary Control System (such as Ash handling system, chemical sampling and dosing system, and air conditioning system) will be controlled through Microprocessor-based Programmable Logic Controllers (PLC), the control and monitor function will be complete through local operator station. The local operation station will be located in local control room or local electronic room. The important signals can be communicated to the Auxiliary System Process Information Network.

I&C Equipment

In order to meet the requirement of safety and economical operation of the unit, the equipment of instrument and control will be of the advanced, mature, reliable, practical technology.

Distributed Control System (DCS)

One set of DCS system will be provided for each new boiler and its auxiliary system. The DCS systems will provide comprehensive process monitoring, control functions, displays, alarming, calculations, data logging, data display, data storage and retrieval, and other functions for each unit and it's associated unit auxiliaries and some Station/Common systems.

Microprocessor-based DCS will be provided with a hierarchy structure, including operation level, process control level and drive level. The unit plant DCS and Auxiliary System Process Information Network interconnected by redundant gateways will be furnished to comply with the requirement of control and monitoring in whole plant.

All power supplies, processors, data highway bus hardware for DCS will be dual redundant.

The spare capacity of 10% will be foreseen in each I/O module, and 10% spare carded will be installed and terminated in each cabinets.

Operator station

The I&C interface is ensured from the operator stations bi-screens graphic LCD color 21" with keyboard and controller, redundant to one another and multi-systems located in the existing control room.

All events and alarms are displayed on the operator stations, recorded, archived and printed stamped in their appearance and disappearance.

Two (2) operator stations will be provided for the boiler DCS system. Two (2) operator stations will be provided for the boiler's FGD-DCS.

Engineer /Programmers Station

Engineering/Programmers Stations will be used for all engineering and diagnostics or maintenance functions including database maintenance, plant/system monitoring changes, graphics/report development, hardware/software diagnostics and development parameters and control equipment with the LCD, keyboard and mouse.

Engineering/Programmers Station will be connected directly to the data highway by redundant net interface It will be used for DCS engineering and configuration.

One (1) Engineering workstation and One (1) History workstation,one (1) server will be provided for the boiler DCS system. One (1) Engineering workstations will be provided for FGD DCS.

Programmable Logic Controllers (PLC)

PLC system will be a complete set and will including following items:

Controller;

Memory;

I/O modules

Interface module;

Power supply;

MMI and computer equipment for local control.

All modules in the system will be of the plug-in type for easy field replacement.

The spare capacity of 10% will be foreseen in each I/O module, and 10% spare carded will be installed and terminated in each cabinets. Each PLC system has own operator/engineer station.

Field Equipment

Primary Element for Flow Measurement

1) In general removable orifice plates with flanges will be used for differential pressure. It will be square-edged, paddle type with concentric orifice. Flow nozzles may be used where high pressure and temperature steam.

2) Orifice plate material will adopt 304 stainless steel, unless otherwise specified, and will conform to the ASME codes. Orifice plate's Beta ratio will not exceed 0.65.

3) The mass flow meter will selected for measurement of fuel oil. Flow meter will implement the measurement, calculations and compensation etc. and 4-20mA signals will be outputted to DCS.

4) The differential pressure method or thermal dispersion mass flow meter will be provided for air flow measurement.

Thermal Sensor

1) Thermocouple will adopt type E or type K thermocouples as defined by IEC584 Standard. Thermocouples will be with duplex elements.

2) Resistance Temperature Detector (RTD) will be of the three-wire system with 100-Ohm platinum (Pt100) resistance elements. RTDs will be with duplex elements.

Process Gauge

In addition to remote transmitters, process gauges will be provided for local indication. The pressure gauge will normally be furnished with bourdon tube or spring tube elements. The accuracy will be +/-1.5% of span.

Transmitter

1) Pressure and differential pressure transmitters will be of capacitance type, 2 wires, and smart sensor. The transmitter will have oil filled bellows/diaphragm as measuring element

2) Differential pressure type will be provided complete with equalizing valve manifold.

3) Transmitters will have easily accessible span and zero adjustment facilities and the accuracy will be less than +/-0.5% of span

Process Switch

1) Switches will provide safe and reliable electrical contract for alarm, interlocks and protection. Set point of the switches will be field adjustable or fixed as required by the process.

2) SPDT Contact will be selected and contact rating will be 230VAC, 3A.

3) Switch will act at the assigned point with accuracy within +/-0.5% of the adjustable range, and will repeat to within 0.25% of the adjustable range.

Actuator

1) In general, pneumatic or motor-driven actuator will be provided for regulating control valve.

2) In general, electric motor drive actuator (400VAC) for on-off valve will be integrated type actuator.

3) The electric actuators will have local control stations, power units, torque and limit switches, anti-condensation heaters, position transmitters (for modulating type only), motor thermal overload protection and indicators.

4) For special applications like fuel oil shut off valve etc. solenoid valves will be used.

Analyzer

1) Zirconia oxygen analyzer will be provided for measuring concentration of oxygen in the flue gas.

2) A set of Continuous Emissions Monitoring System (CEMS) will be provided for each unit.

3) The Conductivity, PH and silicon analyzer etc. will be provided for measuring water quality.

Other Requirements

At least 15% free space will be available in all cubicles, junction boxes. This free space will be distributed inside the cubicles in such way that additional terminals, equipment or modules may be added to any group of controls At least 15% spare cores will be provided in each control and monitoring cable. All spare cores have to be terminated

Power Supply and Air Supply for I&C

Electric Power Supply

Reliable DC and AC power supplies will be provided. For AC power supply, 400VAC with three-phases and four wire, 230VAC with one-phase will be provided. DC power supply is 220VDC.

1) 400VAC Power Supply

400V AC power supply will provide power for motor driven valves, three phases motor driven actuators and other three phases AC equipment.

In general, two way of 400VAC power supplies from different phase of auxiliary low voltage main bus will be supplied. But for some important consumption, such as MCC of boiler and turbine, power supply of motor-driven actuators etc. one will feed from auxiliary low voltage bus, others feed from diesel power supply.

2) 230VAC Normal Power Supply

Power supply failure of equipment which does not effect unit safe operation, will be supplied with 230VAC normal power supply.

3) 230VAC UPS

All vital consumers such as DCS, network, I&C instrument power cabinets etc. shall have two independent power sources; at least one is fed from the UPS system. The equipment such as transmitters shall be fed from DCS power supply system.

5) 220VDC power supply

220VDC power supply is used for I&C protection system and the some control equipment. Two way power supply of 220VDC from 220VDC battery group will be provided for I&C control equipment.

Air Supply for I&C

Air supply for I&C will be special compressed air supply of dry, clean, and oil-less, water-less, dust-less air. The pressure will be 0.6MPa to 0.8MPa. Air supply for air tanks will be sufficient for the designed air consumption quantity for operation of all pneumatic devices and will sustain supply for periods 5 minutes and longer during the procedure for safe unit shutdown.

CIVIL

General

This design covers the civil works for LAL PIR (362MW) power plant fuel conversion project.

Design basis

Chinese standards as follows will be used.

Code for design of building foundation	GB50007-2011
Load code for the design of building structures	GB50009-2012
Code for design of concrete structures	GB50010-2010
Code for seismic design of buildings	GB50011-2010
Code for design of steel structures	GB50017-2003
Code for anticorrosion design of industrial constructions	GB50046-2008
Code for design of chimneys	GB50051-2013
Technical stipulation for the design of civil structure of thermal power plant	DL 5022-2012
Technical code for designing load of main building in fossil fuel power plant	DL/T 5059-2007
Technical Code for Building Pile Foundations	JGJ94-2008
Technical code for testing of building foundation piles	JGJ106-2003

Other basis includes tender documents of this project.

Engineering geology

According to preliminary geotechnical study in tender documents, there are 2 type of soil on this site.

The 1st layer is silty sand, from 0m to 1.0m, and the 2nd layer is find sand, from 1.0m to 10.0m. The 2nd layer can be used as the bearing layer. Seismic zoning of the Power Plant is in zone 2A. The probabilistic analysis shows that expected peak ground acceleration with 10% probability of exceedance in 50 years at site is about 0.16 g. The peak ground acceleration is 0.15g and the corresponding basic seismic intensity is 7 degree. The soil type in site is medium stiff and the site classification is II. Based on seismic condition, soil liquefaction will not be taken into consideration.

Design of architecture

Main power house architecture

Main power house layout

Main power house consists of bunker bay and boiler.

The span of the bunker bay is 11.0m, the longitudinal length is 54.0m. It will be a three stories building and the levels of which are ±0.000m, 12.600m, and 31.500m. Coal handling belts will be at EL. 31.500m.

Boiler is open, there is cover on the top of the Boiler, and the operating floor is 12.600m. The total longitudinal length is 34.8m, the total transverse length is 44.5m.

Equipment complex building will be located near the boiler. It will be a five stories building, and the levels of which are ±0.000m, 6.000m,9.700m,12.600m, and 18.600m. Room will be arranged at respectively according functions. Such as switchgear room, battery room, chemical room, HVAC room, electronic equipment room, etc.

Level and Vertical traffic

Level traffic: One longitudinal passageway will be between the bunker bay and the boiler, the span is 6.5m. The transverse passageways will be arranged at both side of the boiler.

Vertical traffic: Two staircases in bunker bay will be located both sides respectively, which can reach all the layers of the main power house. There are two elevators, which can reach main steel platforms of boiler. One staircase and one steel stair will be located in equipment complex building, which can reach all the layers.

In every stair, passageway, and safety exit, the evacuating board sign are set which are eye-catching in color and outstanding in position.

Lighting and Ventilation

Lighting: The windows will be provided as few as possible for bunker bay, and the artificial illumination is supplied in equipment complex building, and there glaring light should be avoided.

Ventilation

The natural and mechanical ventilation is set for banker bay, and the ventilating facilities are installed on the roof of banker bay.

Fire protection and Explosion protection

Stairs and aisles are laid out reasonably, and conform to requirements in fire protection. The fireproof doors will be used for the electric equipment room, fire wall and staircases.

Construction of the Building

Envelop Enclosure

The bunker bay will be completely enclosed with single steel sheet from 31.500m to the top. It will be open below 31.500m. The roof of bunker bay is reinforced concrete slab.

The exterior wall and interior wall of equipment complex building will be completely enclosed with local clay brick wall. The roof is reinforced concrete slab.

The boiler will be out door structures with a single skin roof only

The 50mm thick expanded polystyrene slab insulation will be used for reinforced concrete roof, and bituminous membrane waterproof sheet will be put on it.

Waterproof

High polymer modified bituminous waterproof sheet will be used for reinforced concrete roof; Polyurethane waterproof coating will be used for ground and floor.

Finishing

Painting will be used on exterior and interior walls of all building. All painting materials will be of high quality, good appearance and weather-proof materials. Special color treatment is to be used for local areas.

Aluminum alloy windows will be used for main power house and other building. Aluminum alloy doors, steel doors, wood doors and fire doors will be used different buildings in accordance function.

Schedule of room internal finishing for main power house

No.	name of room	Floor	Interior wall	Ceiling
1	Bunker bay			
(1)	±0.000m			
	General area	Fine aggregate Concrete		Exterior painting
(2)	12.600m			
	General area	Floor hardener		Exterior painting

(3)	31.500m			
	General area	Floor hardener (with waterproof layer)	Steel sheet	Interior painting
2	**Equipment complex building**			
(1)	±0.000m			
a	Chemical equipment room, Chemical storage	Acid & alkali proof ceramic tile	Acid & alkali proof interior painting	Acid & alkali proof interior painting
b	Switch room	Ceramic tile	Interior painting	Interior painting
c	Ventilator room, Central refrigerating station	Floor hardener	Interior painting	Interior painting
(2)	6.000m			
a	Switch room	Ceramic tile	Interior painting	Interior painting
b	Battery	Acid & alkali proof ceramic tile (with waterproof layer)	Acid & alkali proof interior painting	Acid & alkali proof interior painting
c	Ventilator room	Floor hardener (with waterproof layer)	Interior painting	Interior painting
d	IG541 cylinders room	Floor hardener	Interior painting	Interior painting
(3)	9.700m			
	Cable interlayer	Cement mortar	Interior painting	Interior painting
(4)	12.600m			
a	Electronic equipment room, Relay room, Maintenance room, Engineer workstation room	Ceramic tile	Interior painting	Mineral wool slab acoustic ceiling
b	Sampling room	Acid & alkali proof ceramic tile	Acid & alkali proof interior painting	Acid & alkali proof interior painting
(5)	18.600m			
a	AHU room	Floor hardener (with waterproof layer)	Interior painting	Interior painting

4	Toilet	Non slippery ceramic tile(with waterproof layer)	Interior painting	Aluminium-alloy plate ceiling
5	Staircase	Non slippery ceramic tile	Interior painting	Interior painting

Main Other important Product building

Other main production buildings should be arranged according to technological requirements. Except for special standard, the interior and outer wall should be enveloped by local Clay brick and reinforced concrete roofing should be used at roof, and interior design standard should be followed table as bellowing.

Schedule of room internal finishing for other building

No.	name of room	Floor	Interior wall	Ceiling
1	Commonly productive room	Floor hardener	Interior painting	Interior painting
2	Special chemical room	Acid & alkali proof Ceramic tile	Acid & alkali proof interior painting	Acid & alkali proof interior painting
3	Service room & control room	Ceramic tile	Interior painting	Mineral wool slab acoustic ceiling
4	Electric room	Ceramic tile	Interior painting	Interior painting
5	Toilet	Non slippery ceramic tile(with waterproof layer)	Interior painting	Aluminium-alloy plate ceiling
6	Staircase	Non slippery ceramic tile	Interior painting	Interior painting

Auxiliary building

Workhouse and warehouse

Workhouse and warehouse is single layer building, which total floor area is 800 Sq. The building will have windows and natural ventilation. The ground floor shall be suitable for heavy forklift and truck and for laying down of large, heavy spare parts. Electrical hoist will have to be provided for lifting of heavy spares.

Design of structure

Foundation design

The foundation of main power building will be natural foundation. The 2nd layer will be used. The foundation will be spread foundation. The boiler house will be natural foundation. The 2nd layer will be used. The foundation will be spread foundation, and raft foundation may used partly.

The foundation of chimney will be natural foundation. The 2nd layer will be used. The foundation will be circular plate foundation.

Foundations of other producing buildings and auxiliary building will be natural foundation. The 2nd layer will be used. The foundation will be spread foundation.

Structure design of main building

The main power building will be steel brace-frame structure, which will be steel frame with bracing and connected with high strength bolts. Horizontal load and wind load will be resisted by braces. This structural system has a good seismic performance, and has great economic benefits. It is easy to manufacture and easy to install. Q235-B or Q345-B steel will be used.

Unless otherwise mentioned, the floor of the main building will be cast-in-situ reinforced concrete plate, with steel beam below.

The coal silo will be of steel silo with stainless steel on the sloping surface of inside silo.

The boiler building frame and top hood of boiler will be steel structure. It will be designed and supplied by boiler manufacturer.

The central control building will be concrete structure. It will be apart from the main building and the boiler house.

Chimney

This project uses limestone-gypsum wet desulphurization without GGH. One chimney will be constructed. The height of chimney will be 210m. Outer shield will be reinforced concrete sleeve structure. Two inner flues will be taken. The diameter of inner flues will be 5 5m. Clad steel plate will be taken as anticorrosive method.

Zone behind boiler

Flue support structure will be steel brace-frame structure.

Ash silo will be concrete silo structure. The foundation will be reinforcement concrete circular plate foundation.

Desulfurization Building will be concrete frame structure.

Fan building will be steel brace-frame structure.

ID fan house will be steel brace-frame structure.

Compressor room will be concrete frame structure.

Coal system

Coal-handing tunnel will be reinforced concrete tunnel structure.

The upper part of coal transfer tower will be reinforced concrete frame The underground part adopts reinforced concrete box structure. The floor adopts cast-in-site concrete floor.

coal handling conveyor will be steel truss and the floor will be steel deck putted under concrete floor slab and above steel beam.

Crusher house is reinforced concrete frame structure. Crusher foundation locates on the floor, and adopts concrete block foundation.

The underground part of coal unloading ditch will be reinforced concrete box structure. The upper part will be steel structure.

Circular coal yard will be reinforced concrete wall structure. The roof will be space truss system.

Chemical building

The upper part of chemical buildings will be reinforced concrete frame. The Pond will be reinforced concrete box structure Equipment foundations and channels will take proper method to prevent corrosive as the arrangement professional recommended

MISC buildings and structures

Warehouse and other buildings will be reinforced concrete frame

Pipe supports is steel structure. Horizontal braces will be set if the span of beam is too long.

HAVC

General

Design scope

Ventilation, air Conditioning and dust collection systems will be designed for the proposed buildings/rooms of the power station.

Design code & standards

HVAC system will comply with the following code and standard.

Code for design of fossil fired power plant (DB50660-2011),

Technical code for heating, ventilation and air conditioning design of fossil fuel power plant (DL/T 5035-2004);

Design code for heating ventilation and air conditioning of civil buildings (GB50736-2012).

Outdoor meteorological parameters

Capacity of ventilation and air conditioning systems will be based on the following outdoor design conditions:

According to the specification:

Dry ambient temperature

Base 2005 to 2010 / in ℃	
Yearly mean	26.4
Maximum of monthly mean	43.7
Minimum of monthly mean	6
Mean of monthly maximum	32.7
Mean of monthly minimum	19.6
Absolute maximum	50.0
Absolute minimum	-1
Base 2010 / in ℃	
Mean	26.6
Mini	6.6
Maxi	48.2
Mean variation in one day	11.6
Minimum variation in one day	2.6
Maximum variation in one day	17.6

Wet temperature

Base 2005 to 2010 / in ℃	
Yearly mean	19.9
Maximum of monthly mean	28.5
Minimum of monthly mean	7.3
Base 2010 / in ℃	
Mean	21.8

Mini	5.5
Maxi	36.4
Mean variation in one day	7.1
Minimum variation in one day	2.3
Maximum variation in one day	12.7

According to these data, we can estimate the outdoor design temperature as follows

$t_{wf}=0.71t_{rp}+0.29t_{max}=0.71\times(32.7)+0.29\times(50.5)=37.9$ ℃

$t_{wg}=0.47t_{rp}+0.53\ t_{max}=0.47\times(32.7)+0.53\times(50.5)=42.2$ ℃

$t_{ws}=0.8t_{s\,rp}+0.2\ t_{s\,max}=0.8x(28.5)+0.2x(36.4)=30.1$ ℃

Where,

t_{wf} -----outdoor design temperature for summer ventilation

t_{wg}-----outdoor design dry temperature for summer air conditioning

t_{ws}-----outdoor design wet temperature for summer air conditioning

t_{rp} ----- Maximum monthly average dry temperature for years in succession

t_{max} ----- Maximum dry temperature for years in succession

$t_{s.rp}$ ----- Maximum monthly average wet temperature for years in succession

$t_{s.max}$ ---- Maximum wet temperature for years in succession

Indoor air conditioning design condition:

Room name	summer	
	Temp ℃	Humidity %
—Electronic equipment room, relay	26±1	50±10
—All Local Control Rooms	26~28	N C
—Laboratory, office, duty room	26~28	N C

Ventilation and air Conditioning of central control building

Refrigeration system

A refrigeration station with 3X50% of air-cooled water chillers will be situated in the central control building. The refrigerating system includes three sets of water chillers, three sets of chilled water pumps, one set of automatic water make-up unit, one water treatment unit and one make-up soft water tank.

The makeup water for the chilled water system will be demineralized. The refrigerant will be R134a.

The air cooled water chillers will be located on roof, the chilled water pumps and other equipments will be on the ground floor of central control building. The capacity of the refrigeration station will cover the cooling load needed by the central control building.

Chilled water will be supplied at 7°C and returned at 12°C in summer.

Ventilation of electrical distribution room

2x50% air supply units will be provided for the electrical distribution room. The air cooled by the air supply units will be supplied into the room, and finally exhausted by the return air louver, which will ensure the electrical equipment in normal operation. The inside temperature will not exceed 35°C. In the transitional season, fresh air will be greatly used to save energy, and the walled axial fan will also be used to ventilation. The indoor pressure will be kept positive. The chilled water as cold source is from the central refrigerating system.

Ventilation of battery room

Since no air is allowed to be recycled in the battery room and the inside temperature will not exceed 30°C, air supply unit and axial flow fans will be provided for the battery room. The outdoor air will be cooled by the air supply unit and supplied into the room. The chilled water as cold source is also from the central refrigerating system.

The ventilation rate for the routine ventilation will not be less than 12 times per hour. The indoor pressure will be kept negative. The fan and motor will be of explosion-proof type. The exhaust axial fans will also be used for the emergency fans.

Ventilation of chemical rooms

The chemical laboratory room, sampling room, instrument room will be equipped with fan coils. The chilled water as cold source is from the central refrigerating system. The chemical laboratory room will also be equipped with exhaust axial fan to remove the harmful gases and the exhaust fan will be corrosive proof. The inside pressure will be negative and the ventilation rate will not be less than 15 times per hour.

The chemical storage room and the dosing room will be equipped with natural air intake and mechanical exhaust. The exhaust fan will be corrosive proof. The ventilation rate will not be less than 15 times per hour.

Central air conditioning system

Central air conditioning system will be designed to provide air condition to the rooms in central control building at EL12.600m, such as electric equipment room, engineer station room, relay room, etc.

2x100% air handling units will be adopted for central air conditioning system, one for operation, one for standby. The air handling units will be situated in the AC plant. The supply and return air diffusers/grills will be set on the suspended ceiling of the air-conditioned rooms. The air duct will be hided above the suspended ceiling and insulated.

The air handling unit (AHU) consists of the following sections: return air fan section, mixing box section, low efficiency filter section, cooling section, electric heating section, electric humidify section, medium efficiency filter section and air supply fan section.

In order to ensure the indoor air quality, the minimum fresh air intake will not be less then 10% of the supply air. In the cooling season, fresh air will be greatly used to save energy.

The temperature and the relative humidity of the fresh air, the supply air and the return air will be automatically detected.

Fire fighting and smoke drafting system

The smoke drafting system will be provided for each electronic equipment room. When the fire is detected, the air handling unit/air supply unit will be shut down immediately, and the gas fire fighting system will be started up. When the fire is completely quenched, the fan will start to exhaust the gas. After the gas is exhausted completely, the air handling unit/air supply unit will be started again.

Fire dampers will be provided on ductwork systems passing through firewalls and floors. Dampers will be operated by fusible links and (re-settable) damper motors, suitable for actuation through the fire detection system and fire damper control panel(s). Smoke dampers for fire suppression systems will be motor operated/solenoid actuated for closing and opening purposes. Damper status will be indicated on the control panel mounted adjacent to the fire control panel

Ventilation and dust-removal system of coal handling buildings

Bunker bay

To prevent the coal dust emission during coal unloading, each bunker will be equipped with one bag filter to dilute the concentration of the coal dust. The negative pressure will be helpful to control the dust emission from the coal hopper. Dust-removal system will be interlocked with corresponding belt conveyor and coal plow. The motor of the bag filter will be explosion proof.

Transfer Terminal and Crusher house

Because of the heavy dust pollution, the transfer terminal will be equipped with bag filter and the dust emission spot will be locally sealed. The dust gas will be filtered and exhausted to the atmosphere. The emission concentration of dust-removal system to the atmosphere is not greater than $120mg/m^3$. Dust-removal system will be interlocked with corresponding belt conveyor to achieve interlocked starting and 3min delayed stop.

A water-spray dust suppression system will be supplied where required in order to further minimize the dust emissions. The water spray will be mist in order to pick up the coal dust. Furthermore, rubber curtains will be provided at all coal transfer points in order to limit the coal dust emissions.

Ventilation and air conditioning of auxiliary buildings

Mechanical ventilation system will be provided for the rooms releasing hazardous gas and excess heat.

Mechanical ventilation equipment and split air conditioners will be provided for the local switchgear rooms.

Other buildings like coal handling control room, communication room and local control rooms will be provided with split air conditioners.

HYDRAULIC

Cooling Water System

This project will build one new PC boiler and it would instead the original boiler which is burning HFO. For main cooling water system, the existence cooling tower, the CW pump station, the condenser and the CW pipe are not need be changed. Only some cooling water for Aux. equipment would be provided. The quantity of the closed cooling water is about 200m3/h for the boiler. So the main cooling water system will not change.

Service Water System

The service water will be provided to ash handing system and desulfurization system by pipe net. The water source would be CW blow down water. Total water need quantity is about 68 m^3/h. 10m^3/h for ash handing system make up, 4m^3/h for fly ash wet, 4m^3/h for coal handing wash and coal yard spray and 50m^3/h for desulfurization system. There will be 8m^3/h waste water from desulfurization system should be discharge to the existence power plant. The boiler blow down water will go to the cooling tower basin.

POTABLE WATER SUPPLY & DISPOSAL

POTABLE WATER SUPPLY & DISPOSAL

Potable water supply

Potable water will be supplied from the existing potable water system.

Drainage water

Domestic sewage water system, industrial waste water system and storm drainage system will be provided separately for this project.

a) Domestic Sewage Water System

The purpose of the domestic sewage system is to collect the sanitary sewage disposed by indoor sanitary utensils of all buildings in the plant.

The sewage from buildings will be collected via pipeline into the drainage pump house by gravity and then be pumped to the domestic sewage treatment plant

b) Industrial Waste Water System

Industrial waste water system will collect the waste water such as main building floor washing, oil contained waste water treatment station, equipments & pipes drainage when checked, clarification drainage, , some CW blow down water etc.

All industrial wastewater will be collected via pipeline into the drainage pump house by gravity and then be pumped to the waste water treatment plant.

c) Storm Drainage System

The whole rain water circuit will be provided. This circuit includes particularly roof water, roads and parking water and storm basin water.

The washing water system

The washing water system is responsible for cleaning the floor of the coal convey gallery, coal transfer tower and coal stockyard.

The system is consisted of washing water pumps, washing hose stations, valves and pipe work etc. Two 100% washing water pumps will be installed in the washing water pump house, one pump in operating and the other standby. Containing coal waste water will be drainage to the containing coal waste water treatment station.

ENVIRONMENTAL PROTECTION

Design basis for Environmental Protection

The Gaseous and Particulate emission, Waste Water quality and Noise control will comply with the bid document request.

Atmospheric Emission and Air Pollution Control

Gaseous and Particulate Emission Limits

The maximum values of air emissions and post-treatment are presented in the following table.

Maximal values of air emissions

No	Pollutants	Unit	Plan 1		Plan 2	
			Limit	post-treatment	Limit	post-treatment
1	Particulate	mg/Nm^3	<500	493.29	<50	44.7
2	Sulfur Dioxide (SO2)	mg/Nm^3	No guarantee	—	<850	840.8

3	Nitrogen (NOx)	mg/Nm^3	<510	<510	<510	<510

Treatment Measures for Flue-Gas Pollutants

In order to reduce the flue-gas pollutants from influencing the local environment, the following treatment measures will be adopted, which are reasonable, reliable and widely used in air pollution control of power plant.

1) Continuous emission monitoring system (CEMS) equipment will be provided to monitor the plant stack emissions in accordance to environmental requirements

2) Dust Collection Efficiency will reach 96.8% or above in plan 1 and will reach 99.71% or above in plan 2 meanwhile the dust removal will be used in order to meet emission requirements.

3) For plan 2, the desulfurization efficiency will at least reach 23% to meet emission requirements.

4) The fume will be discharged by stack; the height of the stack will be 210m.

After treatment of flue gas through the emission of pollutants can reach the standard requirements.

Wastewater Treatment

Process effluents quality, this guarantee shall be applicable.

Designation	Maximal instantaneous content (mg/l)
Temperature	influent temp. + max 3
pH	6-9
(BOD)$_5$	80
Total suspended solids -TSS	200
Total dissolved solids -TDS	3500
Oil and grease	10
Chloride as Cl-	1000

Sulphate SO4-	600
Ammonia NH3	40
Sulphide S2-	1
Heavy metals	As specified in EIA

The scope of waste water treatment system contains: sanitary waste water treatment system, waste water treatment system, desulfurization waste water treatment system, rain water recovery treatment system.

In this project, considering the plant has been set the industrial waste water treatment plant, so the industrial waste water produced by this project will be connected to the existing industrial waste water treatment system.

Other details should refer to the "5. CHEMICAL WATER TREATMENT".

Noise Control

Noise Requirements

The noise emissions have to comply with the local laws and regulations

Perimeter noise level

At power plant boundaries, noise level shall not exceed following data:

1) Day time noise limit (6 a.m. to 10 p.m.): 75 dB(A).

2) Night time noise limit (10 p.m. to 6 a.m.) 65 dB(A)

The requirements are applicable for all running mode of the power plant, including in particular start, shut down, soot blowing operation, etc....

Near field noise level

In control room, offices, meeting room, laboratory and rest room, noise level shall not exceed 50 dBA.

Noise level at 1 m from equipment shall not exceed 85 dBA.

The noise level reached with use of standard material considering that in any case noise emitted should not be higher than 90dBA at one meter from source, and that noise emitted by one equipment shall not be higher than 85dBA at one meter from noise source.

Noise Control Measures

Every effort will be made to reduce the noise level inside and outside of the plant to the lowest level as possible. The plant will be designed, constructed and provided with suitable acoustic measures as following:

Firstly, by submitting the requirements to manufacturers, all equipment in this power plant will be designed and operated to have the lowest possible noise level.

Secondly, the noise control measures will be designed to form an integral part of the plant. Sensible design and layout of buildings can minimize transmission of noise, segregation of particular items of plant and to avoid reverberant areas. Therefore, noisy equipments will be layout in rooms as far as possible and far away from the boundary to decrease the noise impact on the surroundings.

Thirdly, some measures such as to install necessary acoustic covers and to use acoustic insulation will be adopted. All the steam safety valves which are likely to be operated often will be provided with silencers to reduce the noise level during steam release.

By adopting noise control measures such as sound-isolating covers and sound-proof materials, occupational exposure to noise levels within the plant will be minimized to close to the noise requirements as previously showed.

FIRE FIGHTING

DESIGN SCOPE

The scope of fire fighting system design includes

--Outdoor hydrant system

--Indoor hydrant and hose reel system

--Automatic fire-extinguishing sprinkler system

-- Gas fire extinguishing system

-- Portable & moveable fire extinguisher

--Fire detection and alarm system

Fire Water System

The fire fighting water will be supplied from the new fire fighting water storage tank. One 100% capacity electric motor driven fire pump, one 100% diesel engine driven fire pump and two 100% capacity electrically driven jockey pumps will be installed for supply of prescribed water to hydrant/sprinkler mains.

The main protected objects for fire fighting water system include the following:

Main Power Building including turbine house and boiler

Coal handling system

Coal yard

Other building and constructing

Automatic fire-extinguishing sprinkler

The fixed water spray system in this plant will used for the fire protection of the conveyor gallery, transfer tower.

Portable & moveable fire extinguisher

The portable & moveable fire extinguisher system will be designed to extinguish the initial fire at the hazardous areas. The quantity and location of extinguisher will be provided in detail design phase.

Fire detection & alarm system

A complete fire detection and alarm system will be provided for the Coal conveying system .

The system will include detector, call point, vary of alarm equipment and control panel. One main fire alarm control will be set in the central control room of the main block and one zonal fire alarm control panel will be set in the control room of electric distribution building for coal handling .

Ash Disposal Site

Site Location

The Ash Disposal Site is located to the north/west area of power plant to allow storage of no sold ashes or even gypsum.

North and west embankment of ash disposal site is a part of new dam for floods.

Ash Data

LAL PIR (362MW) POWER PLANT Fuel Conversion Project Ash Data:

No.	Program	Unit	one unit boiler
			Design coal
1	Ash of 1 hour	t/h	18.2
1.1	Bottom ash	t/h	2.73
1.2	Fly ash	t/h	15.47

2	pyrites	t/h	0.65
3	gypsum	t/h	2.3

Every boiler works 6000 hours per year (calculate according to this number for present)

Design Specification

Ash disposal site's dimensions

The installed capacity of this project is 362MW level unit , in the light of boiler works 6000 hours per year , boiler dispose 11.31×10^4 t ash per year, if the density of ash is 1 t/m^3, the volume of disposed ash is 11.31×10^4m^3 per year, boiler dispose 1.38×10^4 t gypsum per year, if the density of gypsum is 1.1 t/m^3, the volume of disposed ash is 1.25×10^4m^3 per year .

The measure of the ash site , total area is 22770M^2, The height of ash dam is 8m for present,ash height is 7.5m . In this condition, the effective cubage of ash is 7.3×10^4m^3.

The ash disposal site has enough cubage to store 6 month's ash. The volume of 6 month's disposed side is 6.28×10^4m^3.

In the ash disposal site is full after, don't unload ash on the disposal site.

The plan and sectional view of ash site refer to drawing F11151CB1-S2-01.

A ash water setting pond and the reinforced concrete draining well will be build in the ash disposal site, rainwater will be discharged through the pipe that will be buried below ground to ash disposal site to the nearest drainage channel .

Damming material and dam shape

The material of dam body can be found in the locality , such as silty clay、rock ballast. The width of dam body's top is 2.5m, the height of dam is 8m, the inside gradient is 1.2, the outside gradient is 1:2. The inside and outside slope should be protected Detail of the embankments refer to drawing F11151CB1-S2-01.

Environmental protection

In order to prevent the environment from rising ash, we need watering in time in the process of piling up ash.

In order to prevent the environment from rising ash's influence, we must be covering earth on the ash when the height of ash achieve the designed height, or we can plant tree around the ash site.

When the ash site is in working, if we can strengthen management, the ash site can't cause pollution to the environmental.

in order to prevent environmental from rain infiltrate, we must build geomembrane in the bottom of ash site and on the inner slope of ash dam.

Flue Gas Desulfurization (Option)

Design consideration

Design parameter

Design parameter(for one boiler)

Design parameter		Design coal
S .ar		0.55%
Quantity of coal for 1hour		129.8t/h
Temperature after esp		131.65℃
Quantity of flue gas	The actual flue gas	1776007 m^3/h
	Standard dry flu gas	1089724Nm^3/h

FGD Efficiency

According to the requirements of the tender, there are two types of dust discharge program.

a)The first program:$SO2\leqslant850mg/Nm^3$.

100% flue gas of boiler will be desulfurized in this project, one set of desulfurization equipments to handle all gas for unit. Designed FGD efficiency is not less than 23%

b) The second option: without treatment SO2,Without the WFGD.

The Merit Of FGD

Limestone-gypsum wet flue gas desulfurization system will be adopted for the boiler in this project, this system has following characteristics:

Mature technical, high usage ratio and much outstanding achievements.

The desulfurization efficiency can reach to more than 90%

The cost of investment and operation is reasonable

The by-product can be synthetical used, which will not cause second pollution.

The absorbent is cheap, and there is credible source.

FGD System Description

FGD Design Principles

a) One set desulfurizer to handle all the flue gas for the boiler.

b) Blower fan merge Settings with induced draft fan . ,The flue gas was discharged by chimney with out the flue gas heat exchanger (GGH) and bypass flue .

c) Desulphurization plant water, electricity and gas by the public part inside the plant unit into consideration.

WFGD System Design

The limestone-gypsum wet flue gas desulfurization process mainly is consist of absorbent preparation and supply system, SO_2 absorbing system, flue gas system, gypsum dewatering system, limestone and gypsum piling up and transportation system, waste water handling system and so on.

The flue gas fetched out from boiler enters into FGD device, added pressure by pressure boosting fan, then passing GGH system enters into absorber The flue gas flows from bottom to top, which is repeating scrubbed by the atomized limestone slurry, then SO_2 in the flue gas subsequently reacts with limestone slurry to $CaSO_3$, which will be stored in the circulating slurry sump, and oxygen will be provided into the circulating slurry sump by oxidation blowers, and then the $CaSO_3$ will be turned into $CaSO_4 \cdot 2H_2O$ (gypsum), and the gypsum slurry will be sent into the gypsum dewater system by pumps to handle.

FGD Main System

The main system of WFGD

a) Absorbent preparation and supply system

b) SO_2 absorbing system

c) The flue gas system

d) The other system

System drawing F11151CB1-C-03

Absorbent Preparation

One set of limestone slurry preparation system is used in this phase project.

One limestone slurry tank is equipped, which could store limestone slurry consumption of the boiler for 6 hours. To prevent depositing and make slurry symmetrical, limestone slurry tank equipped with slurry agitator.

SO_2 Absorbing system

This system is made up of absorber(including circulating slurry sump, spray bank and mist eliminator), recirculation pump, absorber agitator, oxidation blower and so on.

There are only one absorption tower and three Circulation slurry pumps for this project.

One accident slurry box is equipped for this project. The slurry in the absorption tower will transportant in it when the accident.

Flue Gas System

The FGD system Without the bypass flue

Absorbent Transportation And Process System

There are two set absorbent and process system for this poject

Limestone block will be used as desulfurization absorbent, and truck transportation will be adopted.

Quantity of Limestone

Program		Unit	Design coal
quantity	hour	t/h	1.26

Gypsum Dewater system

Quantity of Gypsum

Program		Unit	Design coal
quantity	hour	t/h	2.3

The gypsum dewater system sets 2 vacuum belt filters. Equipment capacity is about the 75% of gypsum output which is produced by the boiler on the condition of full load.

The capacity of gypsum storage house can store the device of FGD in full load condition for 3 days when using design coal. The gypsum is loaded by bridge grab crane and transported by trucks.

Desulfurization waste water treatment system

The main task of the desulfurization waste water treatment plant is to adjust the pH and to remove the heavy metals and suspended solids. The treated FGD waste-water effluent quality will as per Chinese standard.

To achieve this, the plant consists of the following sections:

Most of the heavy metal ions in waste water will precipitation in the form of hydroxide by adding lime milk;

The rest of the heavy metal ion precipitation in precipitation tank and flocculation tank with TMT 15 and coagulation/flocculation with $FeCl_3$;

By dosing polyelectrolyte suspended solids precipitated in the clarifier;

After pH adjustment the treated FGD waste water will be reused in the ash system for power plant;

Sludge will be conveyed by truck after being dehydration.

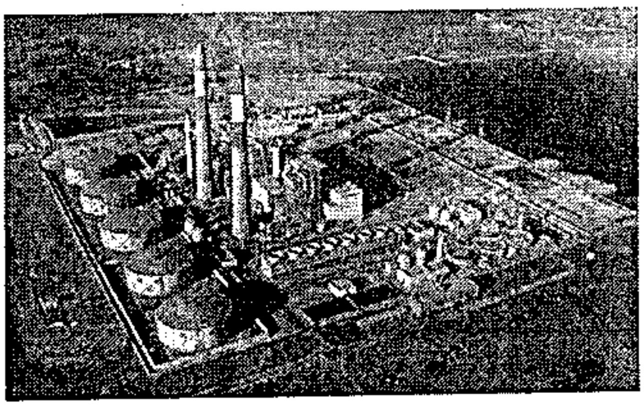
A completely desulfurization waste water treatment system will be provided.

MUZAFFARGARH
Pakistan

LAL PIR/PAK GEN

FEASIBILITY STUDY

COAL CONVERSION



FSR
Feasibility Study Report

31 October 2013

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CONTENTS

1 PROJECT BACKGROUND

1.1 NISHAT GROUP, LALPIR POWER LIMITED & PAKGEN POWER LIMITED

1.1.1 Nishat group short presentation

Nishat Group "NG" is Flagship Owner established in 1951 having most modern and biggest Composite unit of Pakistan.
Nishat Group has grown from a cotton export house into the premier business group of Pakistan with 5 listed companies, concentrating on 5 core businesses: Textiles, Cement, Insurance, Banking and Power Generation.
Today, Nishat is considered to be at par with multinationals operating locally in terms of its quality products and management skills.

1.1.2 LalPir Power Limited & PakGen Power Limited short presentation

Nishat Group has acquired LalPir Power Limited and PakGen Power in 2010.
They are situated near Mahmud Kot, Qasba Gujrat, Tehsil Kot Addu District Muzaffargarh, in the Province of Punjab, Pakistan.

1.2 FEASIBILITY STUDY BACKGROUND

Pakistan is presently facing a serious energy crisis. Despite a strong economic growth during the past decade and the consequent rising demand for energy, no worthwhile steps have been taken to install new capacity for generation of the required energy sources.

Now, the demand exceeds the supply and hence "load-shedding" is a common phenomenon through frequent power shutdowns.
This shortage is badly affecting industry, commerce and daily life of people.

Another point is the excessive price of fuel oil (oil price rising) used in the most power plants and disagreement lived last decade concerning disruption of fuel supply and concerning fuel quality.

The Power Sector & Energy crisis puts Pakistan's economy under an intense pressure.

The Government of Pakistan is very keen to:

- Promote electricity generating system based on renewable energy (water, wind, solar etc.)
- Promote construction of new thermal power plant firing imported coal,
- Convert existing oil firing power plants to a relatively cheaper fuel source like solid fuel.

1.3 INITIAL OBJECTIVES OF THE STUDY AND POTENTIAL REORIENTATION

1.3.1 Preamble

Nishat Group has taken initiative to replace HFO fired in its existing oil fired boilers with imported coal.

Both Nishat Group's plants are located in the same site in Punjab / Muzaffar Garh district, Initial company name, raw capacity, first date for commercial operation, are respectively:

- LalPir Power Limited, installed capacity of 362 MWe started for commercial operation in November 1997.
- PakGen Power Limited, installed capacity of 365 MWe started for commercial operation in February1998.

The feasibility study concerns the opportunities to convert today's HFO fired power plant of LalPir & PakGen Power plant to solid fuel fired power plant.

1.3.2 Initial objectives of the study

The Management of Nishat group has appointed CdF Ingenierie France to conduct feasibility study for the LalPir & PakGen Power plant fuel conversion including the study concerning Pakistanis harbours capacity to receipt imported fuel and the fuel transport from seaports to the power plant site.

The study report cover the aspect listed below for following technical orientations concerning HFO to coal switching.

- Replacement of existing oil fired boilers with new coal fired subcritical boilers

Main covered aspects are appended below:

- Comparison of the different options according to few parameters (technical aspects, coal & ash storage capacity required on site, auxiliary system consumption, capacity loss, execution time, required outage, ...)
- Estimated EPC project cost
- Description of modification required in the existing system
- Potential of Coal storage & handling facilities at seaport, if required description of upgrade option of existing coal handling facilities at sea port
- Specific study to solid fuel transportation from sea port to power plant by railways (connection from port to railways, connection from existing railway to site, number of train required, time required according to seaport location, measure to ensure environmental and solid fuel quality during transport, etc.

During the study, one important point concerning the scenarios with the replacement of the existing boiler was the layout and in particular the new boilers location. This includes to reduce;

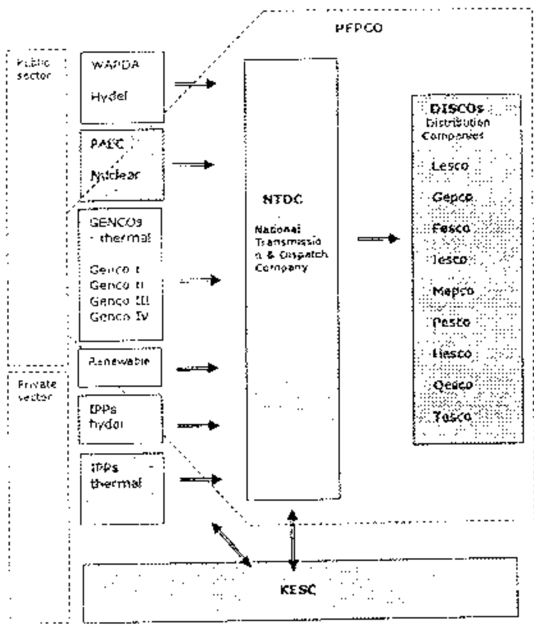
- The existing equipment outage during new boiler erection, but such layout has an impact on unit steam capacity and parameters
- Impact on water / steam cycle and unit efficiency.

After a selection of few layout proposals, the present report will focus on two possible layouts:

- in the HFO storage area, far from the process area including the existing boiler, the steam turbine hall, the feed water system, the cooling tower.
- On the existing switchyard area (close to the steam turbine generator buildings) after relocation of this one.

2 SHORT OVERVIEW ON PAKISTAN ENERGY AND ELECTRICAL SECTOR

2.1 PAKISTAN POWER SECTOR

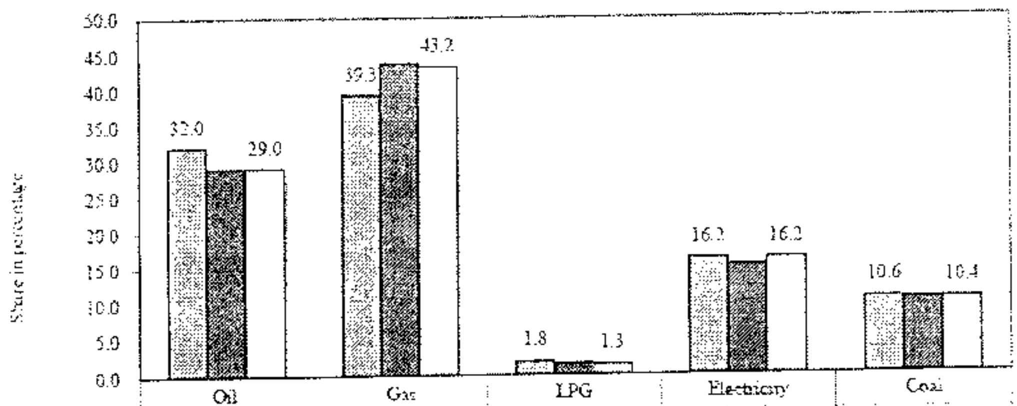


2.2 GLOBAL ENERGY SECTOR

Pakistan's total energy consumption stood at 38.8 millions tonnes of oil equivalent in 2010-11.

The relative importance of the various sources of energy consumption of Liquid Petroleum Gas (LPG), electricity and coal has been broadly similar since 2005-06. The share of gas consumption stood at the highest equal to 43.2 % of the total energy mix of the country, followed by oil (29.0 %).

Energy Consumption by Sources in %: A Comparison between 2005-06, 2008-09 & 20010-11



	Oil	Gas	LPG	Electricity	Coal
2005-06	32.0	39.3	1.8	16.2	10.6
2008-09	29.0	43.7	1.5	15.3	10.4
2010-11	29.0	43.2	1.3	16.2	10.4

Source: Hydrocarbon Development Institute of Pakistan

Pakistan is drastically link to oil and gas energy.
As explained in chapter 7 Pakistan domestic gas resources are decreasing in such way that government take a few years ago decision to limit use of gas for electricity generation.

Even if Pakistan has few fuel oil domestic resources, due to high demand, Pakistan is strongly link to fuel oil international market and is submitted to increasing fuel price.

Combined with the increase in US dollar exchange rate, such price increase of cost of fuel oil penalizes the country's trade balance and debt.

Due to lack of structure, domestic coal and even international coal is used at relatively low level in comparison to countries coal reserves and electricity generating needs.

Renewable energy potential is high in Pakistan country.

- Hydraulic is used for electricity generating (refer to following paragraphs)
- Due to important coastal and presence of wind corridor Pakistan has high opportunity for efficient wind farm. Few projects are under analysis
- Due to his favourable exposure to sun, Pakistan is one of the country were generating electricity by solar will be impacted by improved efficiency
- Geothermal potential
- Biomass potential, in particular few electricity generating units by bagasse firing are under way
- Urban waste use for energy recovery is also under way

2.2.1 Pakistan electric sector main actors

Main actors of Pakistan Power sector are:

- The Ministry of Water & Power has overall administrative oversight on all matters related to Water and Power and plays the lead role in implementation of all policies pertaining to the development of water and power resources of the country.

- Nepra – National Electric Power Regulatory Authority – The Regulator. Nepra's role consists to regulate the Sector by issue of Licenses for generation, transmission & distribution, by tariff determination and by establishing and enforcing performance standards and codes.

- Pepco – Pakistan Electric Power Company. Pepco has an oversight role over operation & development activities of thermal GENCOs for generation, of NTDC & DISCOs for transmission & distribution systems.
For new IPPs, NTDC liaisons with PPIB and provides interconnection points.

- National Transmission and Dispatch Company (NTDC), Under Transmission license from NEPRA, NTDC is engaged in the exclusive transmission business for a term of thirty (30) years from 2002. Control of power transmission and dispatch is allocated to NTDC. Under the regime set out in the Licence the NTDC is entrusted to act as:

  - Central Power Purchasing Agency (CPPA): As the Central Power Purchasing Agency (CPPA), for procurement of power from GENCOs, Hydel & IPPs on behalf of Distribution Companies (DISCOS) for delivery through 500 kV, 220 kV & 132kV Network.
  - System Operator: For secure, safe and reliable operation, control and despatch of generation facilities.
  - Transmission Network Operator: For Operation & Maintenance, Planning, Design and Contract Registrar and Power Exchange Administrator (CRPEA): As CRPEA, to record and monitor contracts relating to bilateral trading system.

- WAPDA – Water and Power Development Authority. After restructuring, its role has been confined to development of New Projects and operation & maintenance of existing hydro power stations.

- AEDB – Alternative Energy Development Board. AEDB mission consists to ensure promotion of electricity generation based on wind, solar, biomass and other renewable resources.

- PPIB – Private Power and Infrastructure Board. To arrange for required capacity additions through private investments & to provide one stop facility to eliminate unnecessary delays in finalization and approval of IPPs. The Power Sector Policy is driven by PPIB.

- Karachi electricity supply company (KESC). The Karachi Electric Supply Company Limited was incorporated on 13th September 1913. The Government of Pakistan took control of the Company by acquiring majority shareholding in 1952. The Company was privatised in 2005. The Company is principally engaged in generation, transmission and distribution of electric energy to industrial, commercial, agricultural and

residential consumers under the Electricity Act, 1910 as amended to date & NEPRA Act 1997 to entire Karachi and its suburbs up to Dhabeji and Gharo in Sindh and Hub, Uthal, Vindhar and Bela in Baluchistan.
Source: PEPCO - Kathmandu, 15th November, 2011

2.2.2 The National Transmission & Dispatch Company

National transmission and dispatch company links the power generation units and load centers dotting the entire country, thus creating one of the largest contiguous grid systems of the world. At present NTDC is operating and maintaining nine 500 kV and twenty four 220 kV grid stations along with 10,167 km length of associated transmission lines.

NTDC power system has following mainly four types of power stations connected to the national grid system:

a. Hydro power stations
b. Steam power stations
c. Gas turbine power stations
d. Combined cycle power plant stations.
e. Nuclear power stations.

The generating units are loaded according to the merit order determined by their cost of operation and synchronized with system with the rising trend of load curve.

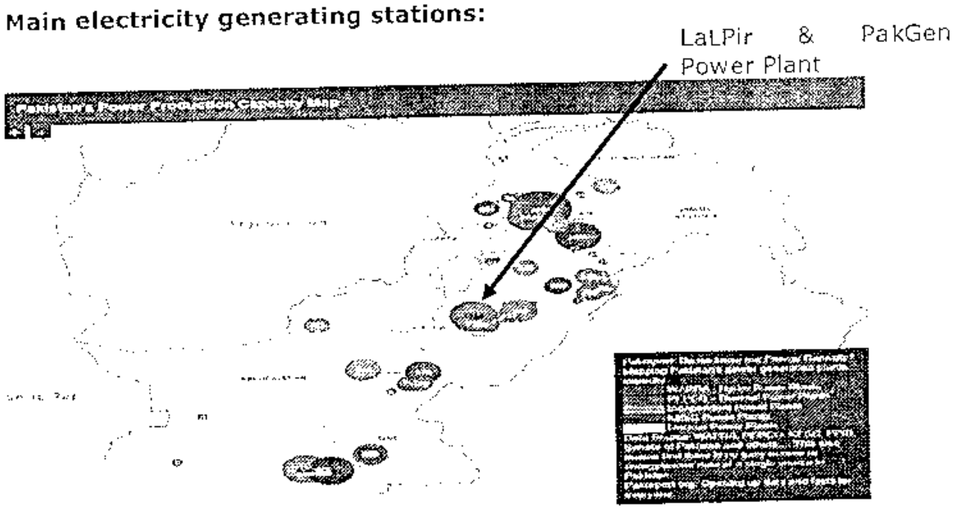
However sometimes it is necessary to take generation at high operational cost subjected to constraints such as less transmission or transformer capacity. All the functions of 500/220 kV power system and power houses are monitored by SCADA system through RTUS installed at the grid/power stations

NTDC is responsible to purchase the power from hydel stations in the north, thermal units in public and private sectors installed mostly in the central southern regions of the country and to sell power to distribution companies through its large network of transmission lines and grid stations of 500 kV and 220 kV voltage capacities

2.3 TODAY ELECTRICITY GENERATING CAPACITY AND ELECTRICITY DEMAND

2.3.1 Production capacity

Main electricity generating stations:



Power generation is provided by thermal plants, hydroelectric facilities and a small nuclear facility (300 MW).

The 13 hydroelectric facilities (installed capacity 6,481 MW) are owned and operated by the Water and Power Development Authority (WAPDA), a public sector entity.

Thermal power plants are owned by public and private companies.

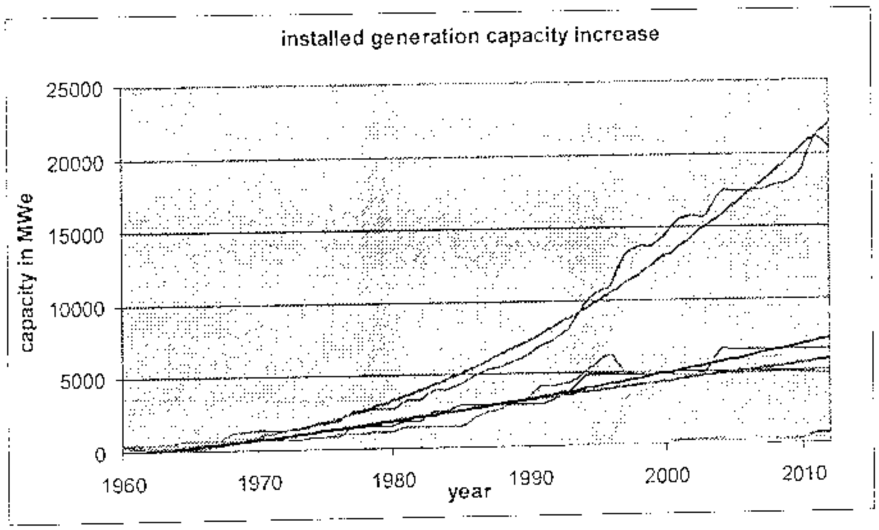
The public sector operates 13 thermal power plants (installed capacity 4,900 MW). About a third of Pakistan's generation (5,987 MW) is provided by private sector companies (independent power producers or IPPs).

Also, KESC operates plants with a total capacity of 1,955 MW.

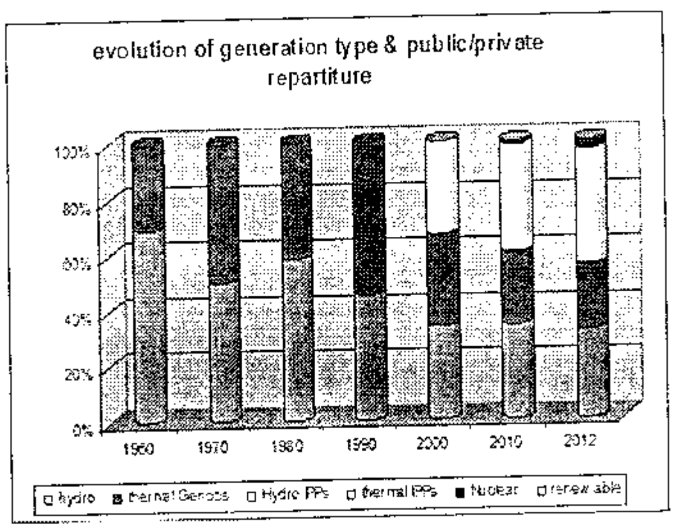
Out of the total 19,252 MW of the national installed generation capacity, dependable generation is about 17,523 MW in the summer and about 14,640 MW in the winter, depending on the annual hydrology.

Generating capacity increase since 1960:

Following figures describe installed generating capacity increase since 1960 :

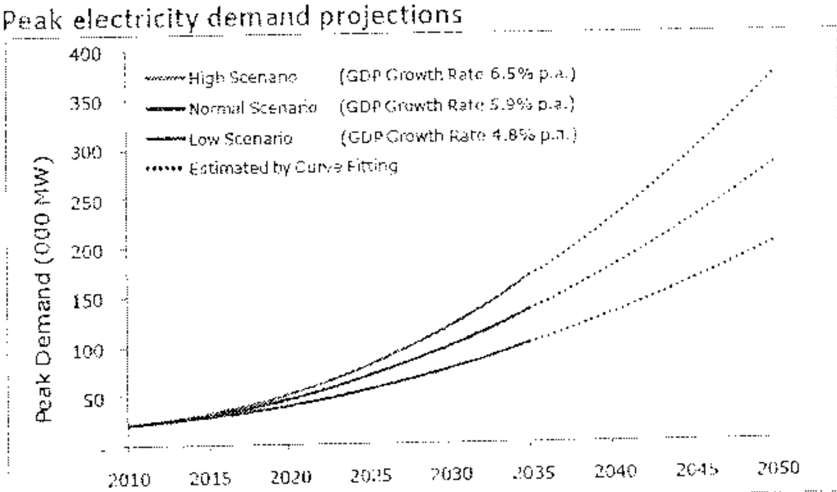


Total generating capacity
Genco's thermal PP
Wadpa Hydro PP
IPP's thermal PP
IPP's hydro PP
Nuclear PP
Renewable PP



	total generating capacity (Mwe)
1960	366
1970	1323
1980	2685
1990	6409
2000	14444
2010	18892
2012	20443

2.3.2 Potential electricity demand projections



	2010	2020	2030	2035	2040	2050
High Scenario	20.2	50.4	117.1	169.4	226.0	373.7
Normal Scenario	20.2	45.4	97.5	134.8	177.1	283.4
Low Scenario	20.2	38.7	74.5	100.5	129.2	201.7

Source: National Transmission and Dispatch Company (NTDC), 2010

2.4 ENERGY SHORTFALL AND LOAD SHEDDING

2.4.1 Preamble

Pakistan is presently facing a serious energy crisis due to Energy shortfall and load shedding due to lack of generating capacity, excessive cost of HFO impacting global electricity generating cost.

Despite strong economic growth during the past decade and consequent rising demand for energy, no worthwhile steps have been taken to install new capacity for generation of the required energy sources.
Now, the demand exceeds supply and hence "load-shedding" is a common phenomenon through frequent power shutdowns.
This shortage is badly affecting industry, commerce and daily life of people.

A other point is the excessive price of fuel oil (oil pricerising) used in mainly power plant and disagreement lived last decade concerning disruption of fuel supply and concerning fuel quality.

Power Sector & Energy crisis make Pakistan economy under intense pressure.

Shortage can be explained by few reasons including:

- Lack of generating unit

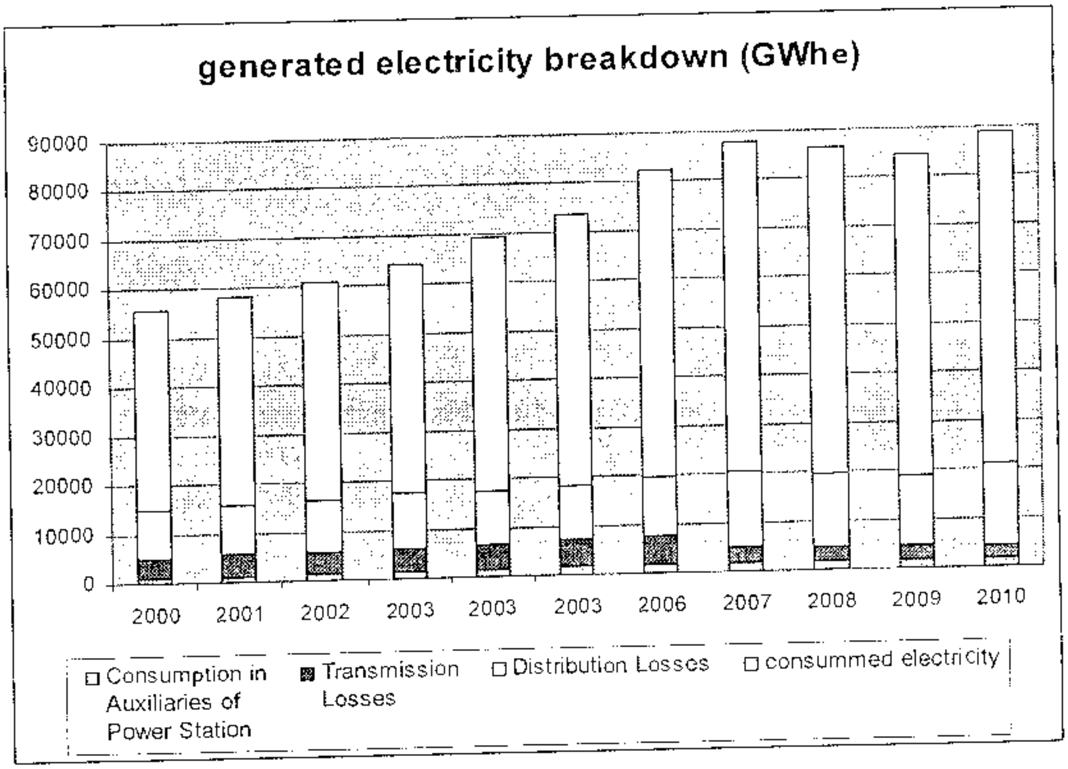
- Degradation of some existing unit
- Transport and distribution networks losses
- Fuel supply shortage
- Impact of natural disaster
- Seasonal impact on generating capacity

2.4.2 Some paramaters generating today situation

2.4.2.1 Transport & Distribution losses

Transmission and Distribution losses vary from month to month depending on weather conditions and industrial / agriculture demand in particular.

The below figure shows generated electricity evolution from 2000 to 2010



2.4.2.2 Lack of HFO and natural gas

The electricity shortage that currently fluctuates between 1,000 and 3,000 megawatts is likely to worsen in a few days because of problems of transporting furnace oil and diesel through the railway system and other means.

Pakistan electricity generation has also to face natural gas shortage as shown on the below table based on Pepco data (average gas requirement versus actual gas supplied to Gencos power stations)

	GENCOs			IPPS			GENCOs + IPPs	
year	Required Gas	Gas available	Gap	Required gas	Gas available	Gap	Total Gap	Availability (%)
2005-06	735	583	152	671	524	147	299	79%
2006-07	735	451	284	671	523	148	432	69%
2007-08	735	438	297	671	491	180	477	66%
2008-09	735	405	330	671	408	263	593	58%
2009-10	735	361	374	671	391	280	654	53%
2010-11	735	267	468	671	358	313	781	44%

- *units are MMCFD*
- *Concerned period is July & June*
- *Kesc supply (182 MMCFD is not included)*

2.5 PAKISTAN GOVERNMENT TODAY'S MEASURES TO TACKLE ENERGY SECTOR CRISIS

Government of Pakistan is very keen to:

- Promote electricity generating system based on renewable energy (water, wind, solar, ...).
- Promote construction of new thermal power plant firing imported coal.
- Convert existing oil firing power plants to a relatively cheaper fuel source like solid fuel.
- Reduce transmission & distribution losses.

As introduce in above §, Government is strongly involved in a policy designed to promote energy production and the reduction of this electricity HFO.

The Government of Pakistan is focused on tackling the power crisis in the country. Its Policy for Power Generation Projects of 1994 and subsequently of 2002 aimed to promote private investment in the sector. As a result, 28 IPPs are currently operating in the country with gross installed capacity of 8,386 MW (39% of total production capacity).

To cope with the severe power shortages anticipated in the near future, the Government of Pakistan has introduced extensive plans to develop hydropower, coal and wind resources and introduce more gas-fired generation.

But due to time constraints, the Government of Pakistan has requested the IPP's to make proposals to expand their capabilities on a fast track basis under the framework of the Policy for Power Generation Projects 2002.

Government of Pakistan (GOP) is keen to looking after the option to convert the existing HFO fired power plants on coal to cope up the fuel prices increase issue. Pursuant to this, the owner is intended to replace its existing oil fired boilers (2 x 1200 ton/hr) with coal fired sub critical PC boilers.
The Government of Pakistan has initiated a number of measures to incentivize IPP's, which include:

- Guaranteed USD based returns

- One window operation through PPIB to facilitate the investors
- Adequate cost indexations
- Monthly review of fuel charges
- Fiscal incentives
- Guaranteed off-take of power produced
- Fast tracked regulatory approvals

The below table show some example of fuel conversion projects

Power Plant	Gross De-rated Capacity (MW)	Gross Improved Capacity (MW)	Imported Coal Required (Mt/a)
GENCOS			
TPS, Jamshoro	667	807	2.3
TPS, Muzaffargarh	1025	1282	3.6
TPS, Faisalabad	97	125	0.4
Total	**1,789**	2,214	6.2
IPPs			
HUBCO	1292	1292	3.2
AES Lalpir, Muzaffargarh	362	362	Defined in following chapters
AES Pakgen, Muzaffargarh	365	365	
Saba Power, Sheikhupura	134	134	0.3
TPS, Bin Qasim, KESC	1120	1197	3.2
Sub-Total	3,273	3,350	8.6
Grand Total (GENCO, IPPs & KESC)	**5,062**	**5,564**	**14.8**

3 PAKISTAN CLIMATIC BACKGROUND

3.1 SITE LOCATION

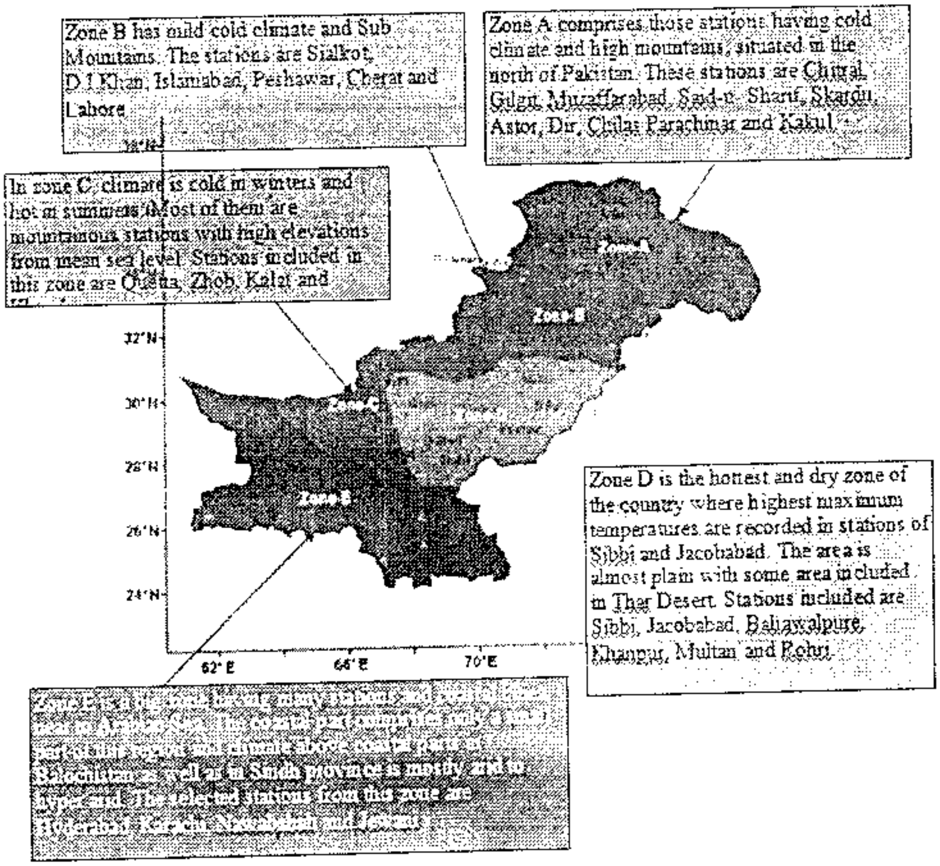
The power plant site is located near the town of Mahmud Kot, in the District of Muzaffargarh, Punjab Province.

- Latitude: 30°10'23"
- Longitude: 70°59'35"
- The site elevation is approximately 117 to 122 m above mean sea level (MSL).

3.2 CLIMATE CONDITIONS

Depending on the topography, there is an extreme variation in the temperature of Pakistan. The country is essentially arid except for the southern slopes of the Himalayas and the sub-mountainous tract where the annual rainfall varies between 760 and 1270 mm. This area has humid sub-Tropical climate. In the extreme north - because of great heights - Highland climate prevails.

A classification by main area was conducted in July 2012 within a study designed by "Rainfall Trends in Different Climate Zones of Pakistan", following figure is a summary of designed classification:



The District Muzaffargarh (located in above area or zone D) has extreme hot and cold climate throughout its area.
Almost all the area of Thesil Alipur and some parts of Muzaffargarh Thesil are flooded each year.

3.3 NATURAL RISKS & CONTRAINTS

The Power plant site is submitted to several types of risks and constraints like:

- Earthquakes:

According to "The Building Code of Pakistan", Chapter 2 "Seismic Hazards.", the Power Plant is in the seismic zone 2A.
The probabilistic analysis for Pakistan shows that expected peak ground acceleration with 10% probability of exceedence in 50 years at site is about 0.16 g.

- Floods:

The monsoon rains are usually observed between July and September. The accumulation of water in North province due to excessive monsoon rains can flood certain areas of Punjab Province and in particular the Site.
The site is protected by dams. This principle will be extended during project construction and will include train access, coal delivery station, coal yard and combustion residues disposal.

- Extreme temperature, high wet bulb level:

In summer, Pakistan, an in particular the Site can be exposed to very high ambient temperature (equal or even more than 50°C) and can be submitted to drought.
As shown on below graphic, in summer the power plant cooling system is submitted to very high wet bulb.
Such conditions will also strongly impact gas combustion and NGCC capacity.

- Dry period and Drought

The Winter period is characterised by dry period, impacting rivers flow.
Such climatic conditions strongly impact the hydro power plant capacity as shown in the following chapter.

- Winds:

The site can be submitted to strong winds,
In combination with high temperature and drought, winds can generate particles/dust emissions from the future coal yard.

- Rain falls:

Even if the Site in more known as a hot and dry zone, it can be submitted to consequent rain falls period.
It has been decided to consider the impact of a long and heavy rain on coal storage (wet coal will increase risk of coal handling & crusher clogging and unit efficiency & reliability by notably mills capacity decrease and boiler efficiency decrease).
Such climatic conditions will also be considered for access (boiler will be fitted with on cladded staircase, etc). Rain intensity shall also be considered for effluents and rain drain system including capacity of storm basin / polluted water basin.

4 INTRODUCTION TO LALPIR & PAKGEN POWER PLANT AND SITE MAIN CHARACTERISTICS

4.1 BRIEF HISTORY

LalPir Power Limited (formerly AES LalPir Pvt Limited) & Pak Gen Power Limited (formerly AES Pak Gen Pvt Company) was incorporated in Pakistan in 1994 under the Companies Ordinance, 1984 by AES Corporation of USA. LalPir & PakGen was established under Government of Pakistan's Policy for Power Generation Projects of 1994 as an Independent Power Producer ("IPP") to own, operate and maintain an oil fired power station ("the Complex"), having gross capacity of 362 MW & 365 MW respectively in Mehmood Kot, Muzaffargarh, Punjab, Pakistan. It commenced commercial operations in November 1997. The electricity generated is purchased by WAPDA under the Power Purchase Agreement ("PPA") executed with the Company for a period of 30 years (with effect from commencement of commercial operations in November 1997 & February 1998 respectively).

In June 2010, AES LalPir Private Limited & AES Pak Gen Company was acquired by Nishat Group consortium.

After the acquisition, both Companies under the new management converted from a private limited company into a public limited company and the name of the both Company was also changed from AES LalPir (Private) Limited to LalPir Power Limited and from AES Pak Gen (Private) Company to PakGen Power Limited.

4.2 TODAY AGREEMENTS ANO CONTRACTS

REGULATORY APPROVALS/OPERATIONAL CONTRACTS

LalPir Power Limited has been issued a Generation License by National Electric Power Regulatory Authority ("NEPRA"). Other Key approvals/operational contracts are listed below:

Key Contracts	Counter Party	Execution Date
Implementation Agreement (IA)	President, Islamic Republic of Pakistan	September 24, 1994
Power Purchase Agreement (PPA)	WAPDA	November 3, 1994
Fuel Supply Agreement (FSA)	Pakistan State Oil Company Limited	November 6, 1994
GOP Guarantee	Government of Pakistan	May 15, 1995

PakGen has been issued a Generation License by National Electric Power Regulatory Authority **("NEPRA").** Other Key approvals/operational contracts are listed below:

Key contracts	Counter Party	Execution Date
Power Purchase Agreement	WAPDA	September 5, 1995
Implementation Agreement	President, Islamic Republic of Pakistan	September 24, 1994
Fuel Supply Agreement	Pakistan State Oil Company Limited	September 7, 1995

4.3 TECHNICAL DATA

4.3.1 Presentation

Plants are operating at its gross capacity of LalPir: 362MW and PakGen: 365 MW. Both plants have 1200 tons/hr Mitsubishi Heavy Industries (MHI) oil fired forced circulation boilers, single reheat condensing steam turbines and Hydrogen cooled Parson's generators.

The plants are connected with the WAPDA system through 220 KV grid station. Each unit has one Generator Step-up Transformer (24 KV to 220 KV), one start-up transformer (220 KV to 11 KV), one auxiliary transformer (24 KV to 11 KV). Each unit is equipped with 2 X 100% outgoing transmission lines.

DCS employed is "DIASYS Netmation" and is designed by MHI. Software Package used for different DCS components (ACS, EMS, OPS etc) is "DIASYS Netmation Build 53 SP5".

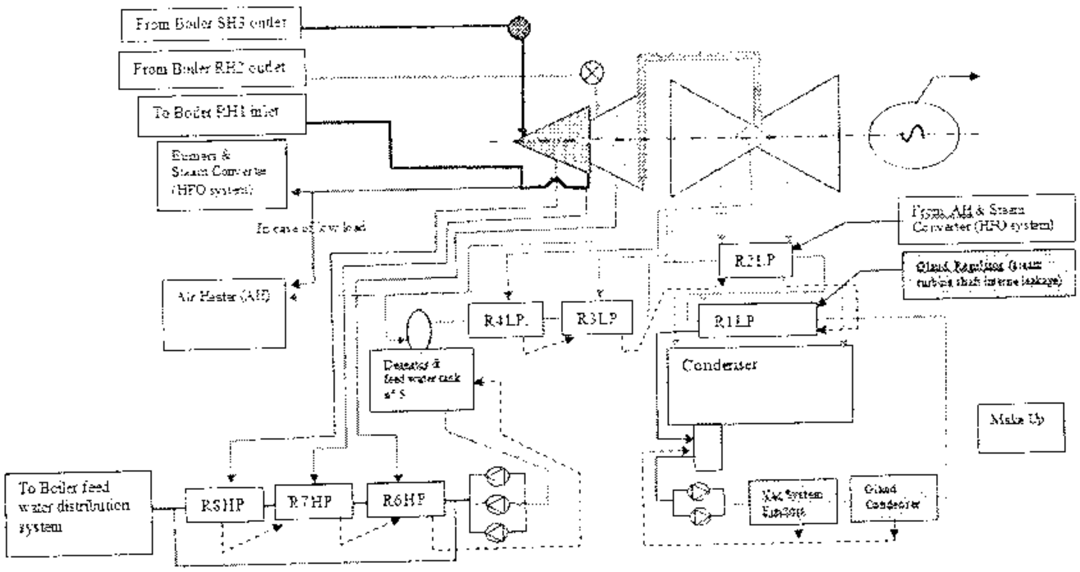
The whole control system of the plant is divided into six sub-systems and multiple process station (MPS) is applied to each sub-system to perform automatic plant control and I/O processing.

Both units are equipped with 1.0 MW emergency diesel generator that feeds the emergency bus to run plant essential services in case of blackout.
The plants have five RFO tanks with storage capacity of 30,000 m3 each, and two Diesel tanks with storage capacity of 600 tons each. Water is supplied to plants by two sources i.e: ground and canal. De-mineralized water capacity is 65m3/hr for each unit. Cooling water is supplied from induced draft cooling towers of capacity 35,000 m3/hr for each unit (i.e. 32,800 m^3/hr to condenser & 2,200 m^3/hr to cooling water circuit). Eight cooling tower fans are installed on each cooling tower. Three cooling water pumps of capacity 17,500 m^3/hr for each unit is used for supply of cooling water to condenser.

4.3.2 Short description

Today, the LalPir/PakGen power plant is composed by:

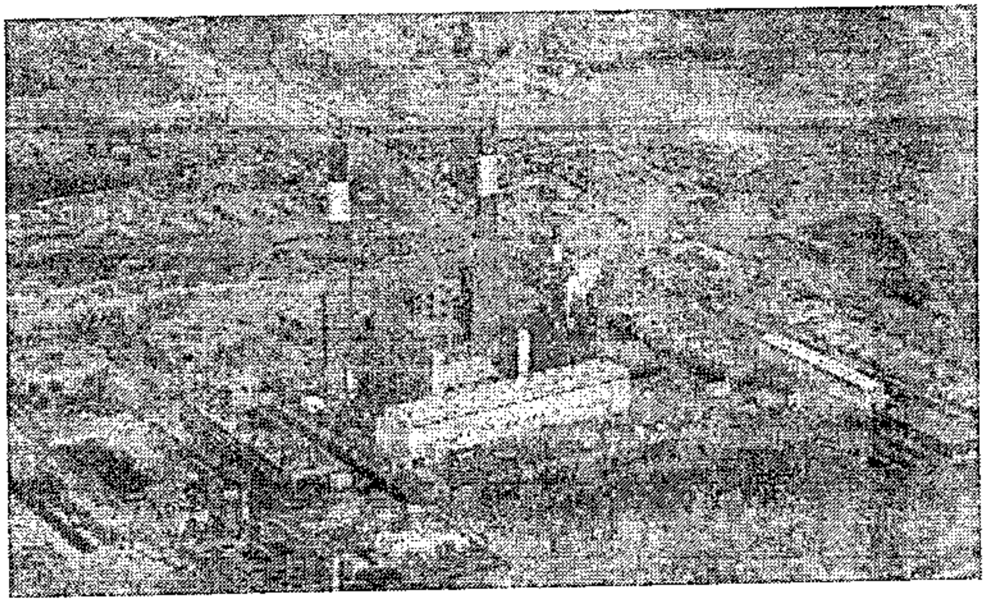
- Two heavy fuel oil (HFO) fired units, each consisting of:
  - One HFO fired boiler deserving one steam turbine (of single reheat & condensing type) with HP and reheated IP steam
  - One steam turbine in two parts (one HP/IP turbine and one LP turbine) fitted with :
    - On HP turbine part : two extractions (one concerning cold IP steam) sending back to boiler part of the steam for reheating
    - On IP steam part: on inlet connexion for reheat IP steam from boiler, two extractions (one concerning steam connexion to LP turbine)
    - On LP turbine, two steam exhaust facilities connected to hydro condenser and four extractions to feed the four level of condensates LP reheaters

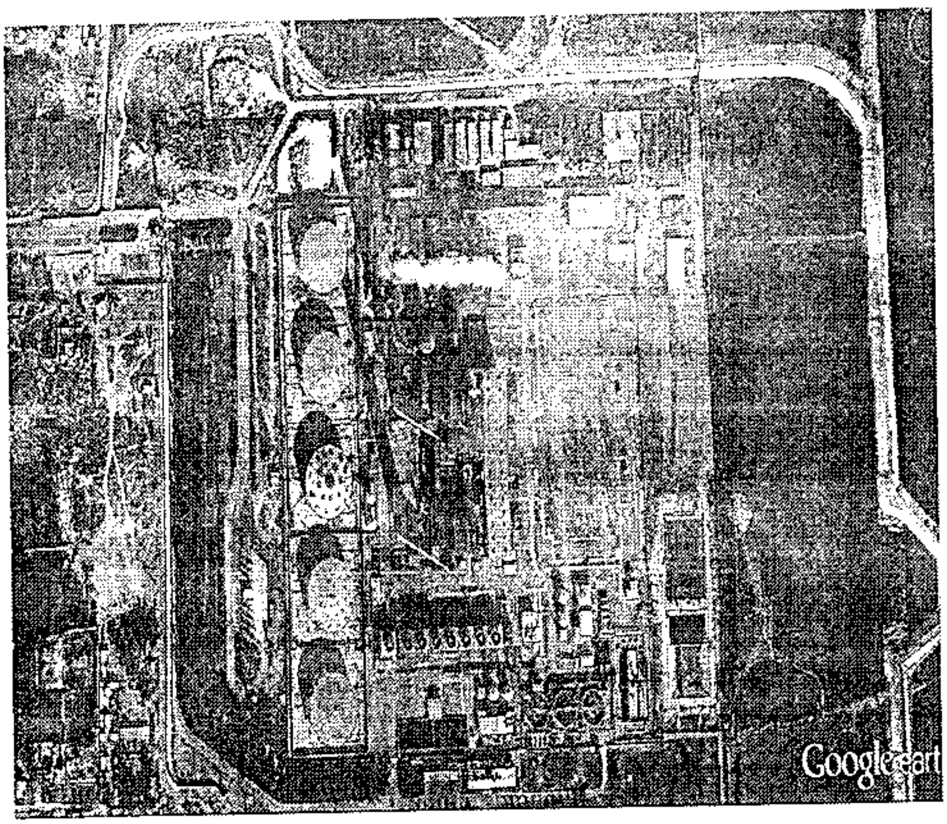


- One hydro condenser with in particular two redundant electrical pumps
- One generator connected to above turbines (one common shaft) and producing electricity under 24 kV voltage with power at generator terminal of 362MW (LalPir) and 365MW (PakGen).
- One main transformer to allow voltage increase to 200kV prior to generated electricity delivery to HT switchyard and Grid, one auxiliary transformer to ensure feeding of all auxiliaries.
- One HFO and HSD distribution fuel up to concerned burners
- One main cooling circuit including;
    - One cooling tower composed by 8 cells with Induced mechanical draft each
    - One set of three pumps

- Five HFO tanks of capacity 30,000 m3 each
- One HFO handling system including for each unit,
    - a pumping station insuring transfer from trucks to tanks and, for tanks to boiler burners
    - a steam converter insuring by use of steam extracted from steam turbine, heat of "auxiliary" steam insuring heating needs on HFO tanks, HFO conditioning
- One HSD system for warm up, ignition burners & low load operations, insuring fuel transfer:
    - Above designed ignition burners of each main boiler
    - Emergency diesel feeding
    - Auxiliary steam boilers

The below photography are a general view of the existing installation & a lateral view of LalPir unit power block:





5 ENVIRONMENTAL & CLIMATE CHANGE POLICY – MDB REQUIREMENTS

5.1 NEQS REQUIREMENTS

Concerning the allowed atmospheric emissions, effluents characteristics & noise limitation, the installations will be submitted to National Environmental Quality Standards (NEQS 2000) first implemented in 1993 and were amended in 1995 and 2000.

In Particular, for atmospheric emissions, the following data shall be respected (in mg/Nm^3):

- NOx :
  - For coal: 850 (300g/J)
  - For lignite: 750 (260g/J)
  - For HFO: 500 (130 g/l)
- SOx:
  - In low polluted area : less than 400t/day
  - In high polluted area: less than 100t/day
- PM (particle matters): 500

5.2 INTERNATIONAL FINANCE CORPORATION AND OTHER MDB - MULTILATERAL DEVELOPMENT BANKS REQUIREMENTS

Multilateral Development Banks (MDBs) are international institutions that provide financial assistance, typically in the form of loans and grants, to develop countries in order to promote economic and social development.

The World Bank is the oldest and largest of the MDBs.
The World Bank Group comprises three sub-institutions that make loans and grants to develop countries:

- the International Bank for Reconstruction and Development (IBRD),
- the International Development Association (IDA), and
- the International Finance Corporation (IFC).

Much of the banks are aligned with the IFC requirements.

For coal firing, IFC requirements (or even called MDB requirements) are the followings (in mg/Nm^3) :

- NOx : 510
- SOx: 850
- PM (particle matters): 50

5.3 PROJECT ENVIRONMENTAL DATA CONSIDERED

The present report considers the MDB requirements for each boiler emission limits:

- NOx : 510 mg/Nm^3
- SOx: 850 mg/Nm^3
- PM: 50 mg/Nm^3

6 SPECIFIC RUNNING CONDITIONS WHICH SHALL BE CONSIDERED IN CASE OF FUEL CONVERSION

According to initial HBD, mean steam conditions at turbine inlet / outlet can be considered as following.

At nominal load (100% MCR), each HFO boiler supplies steam and meets steam requirement at turbine inlet such that:

- Steam condition at HP turbine inlet = 166.7 bara (169 Kg/cm²) & 538 °C
- Steam condition at IP turbine inlet (HRH) = 38 Kg/cm² & 538 °C
- Steam condition Cold ReHeat (at HP turbine exhaust) = 40 Kg/cm² & 335 °C
- HP steam Flow at HP turbine inlet = 1125 Tons / hr (upstream to HP steam turbine, about 0.56 t/h is extracted to supply gland steam condenser). At BMCR, steam flow will be 1200t/h.
- IP Steam Flow at HP steam turbine outlet = 986.85 t/h with following distribution:
- 894 t/h to boiler reheater
- 17.86 t/h to Steam Convertor (for HFO heating - HFO storage & handling system)
- IP outlet steam flow (+ part of steam flow delivered by HP steam turbine sealing system) is delivered to LP steam turbine (about 50%), to deareator and (for a flow of 25.82 t/h) to boiler steam air heater to increase air temperature up to 63°C (with ambient air at 25°C)
- Feed Water Temp at HP-HEATER # 8 Outlet = 275 °C.
- It can be pointed out that the main water / steam flows filled or extracted from the steam turbine/condenser/feed water system are at nominal load:
- Feed water at HTR n°8 outlet: 1130.7 t/h at 275 °C
- HP Steam from boiler : 1130.7 t/h - 166.7 bara/538°C
- Reheated IP steam from boiler :894.0 t/h - 36bara / 538°C
- Cold IP steam to boiler steam / air heater: not considered at nominal load (please refer to IP steam turbine outlet)
- Condensate return from boiler air/steam heater to HTR n°2 : 25.82 t/h

- Make up to condenser to compensate steam consumption on HFO burners: 3.1 t/h of dematerialized water

7 RETROFIT OF THE EXISTING POWER PLANT

7.1 ALTERNATIVES

When a decision is made to change the boiler of a group of power production for economic reasons related to changes in fuel prices, two alternatives are possible:

a) Demolish the existing boiler and rebuild the new boiler in place of the old one.

b) Build the new boiler in an open field near the existing boiler room and only when the new boiler is in operation, demolish the old one.

Comments on the alternative a):

Its main disadvantage is the loss of very important production related to the outage group.
We can highlight the existing power shortage.

This outage may exceed three years. Indeed, we must at first destroy the existing equipment will be replaced and when soils are remediated (soil clean up performed) build the new boiler. We can estimate at six months the first phase and 2.5 years for reconstruction.

The advantage is that the new boiler is finding the place of the old, it is in the best position to supply the existing turbine. The steam piping network is optimized.

Comment on alternative b):

- The main advantage of this alternate (b) is to minimize the downtime of the existing slice and avoid a significant loss of production.

- The outage corresponds to :

    - The connections of steam pipes, feed water and other fluids
    - Replacement of existing equipment to match with new project life, either due to limitation of equipment life cycle and/or their under-sizing in the new configuration,
    - Adaptation of the monitoring and control of the new boiler in line with the driving equipment of the turbine and its auxiliaries,
    - Commissioning of new equipment, testing and verification of security.
- A disadvantage of this solution is to remove the boiler from the existing place and greatly increase the length of steam and feed water piping connection.

The consequences of this separation are:

- increase the price of water steam piping,

- increase heat loss related to pipelines,
- increase the pressure drop of the same pipe network with the effect of increasing the consumption of feed water pumps motors,
- modify the conditions of the admission steam turbine IP.

According to the above analysis (conversion of existing boiler and integration of subcritical boiler), due to the existing unit age and status, to power sector shortage, it appears that implementation of new subcritical coal fired boiler should be the right solution.

7.2 NEW SUBCRITICAL PC BOILER

In case of a new subcritical coal fired boiler, it has been demonstrated that the steam water system is preserved within the following parameters:

- The layout and the distance between boiler & steam turbine
- HFO system dismantling

In the last case, the challenge consists to conserve steam turbine inlet data and to conserve pressure design of feed water system (even if feed water pumps has to be retrofitted or replaced).

The main constraint of this project will be linked to the layout possibility and the requirements consisting in ensuring the correct input data at steam turbine inlet(s).

The investigations were launched for few scenarios, after evaluation only two scenarios were conserved.

The choice to abandon other proposals was mainly due to:

- Difficulties to manage second phase concerning existing boilers dismantling etc.
- Difficulties to manage HFO storage during temporary erection time (one HFO tank at each side of existing HFO area, etc.).

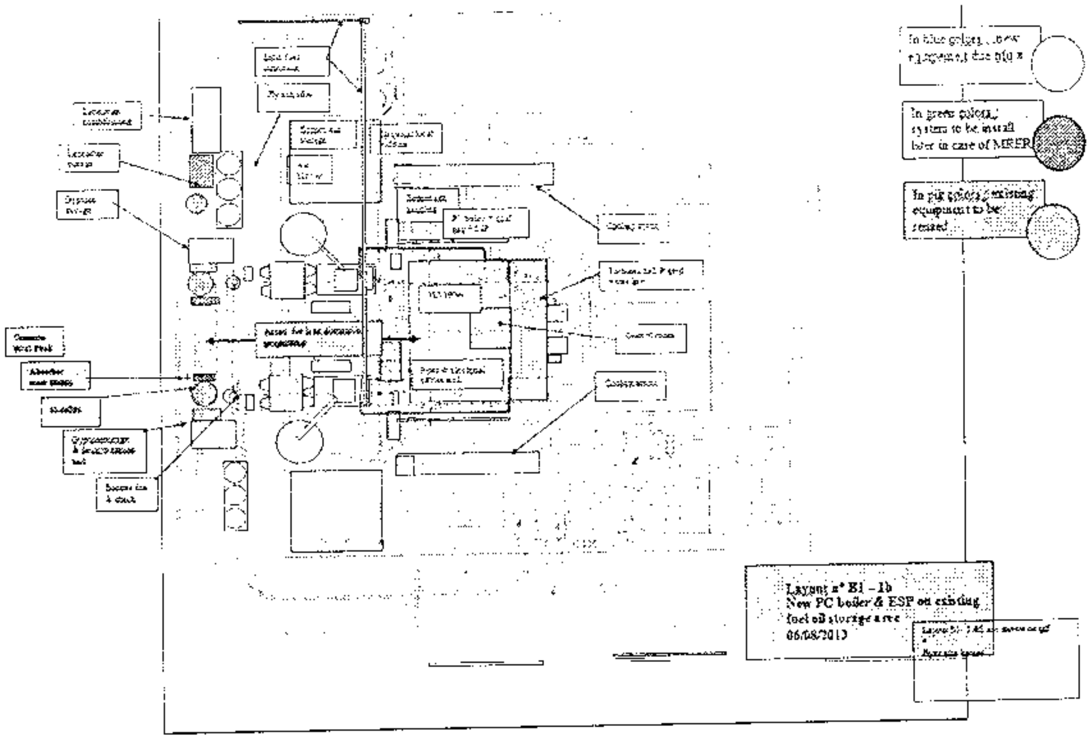
Additional analysis will concern the both following proposals:

- Solution 1 – boiler at the location of the HFO tanks
- Solution 2 - boiler at the location of the 220 kV switchyard

7.2.1 Solution 1

7.2.1.1 Description

Solution 1, consists to implement new boilers on HFO tanks area after dismantling of mainly the central 3 HFO tanks and the corresponding retention, two external (one north, the other in south) and existing HFO pumping station and steam converters are preserved.



Solution 1

An access to the existing boiler is preserved to allow dismantling after coal fired boiler (access from west side between the two coal units).

Compared to the existing situation (without considering drum height difference) new pipes rack will have an additive straight length of about 185/190m or about 220m including additional loops to insure pipe flexibility.

7.2.1.2 Preparatory works

With the solution 1, it will be necessary to organize the deconstruction of several existing fuel tanks. On the 5 existing fuel oil tanks, the deconstruction of 3 tanks (Nr 2, 3 and 4) may be necessary to free enough space for the erection of the new boilers. The remaining HFO tanks will allow minimizing the outage of both existing units during the erection of the new boilers.

For the part concerning power supply and I&C of the new equipment, there is a very little difference between both solutions. The impact is essentially at the level of the cable lengths to implement and particularly at the level of 11 kV cables between the new boiler switchboard and the existing 11 kV switchboards (most consistent lengths for the solution 1).

For solution 1, it can be considered that the impact of the electrical part related to the deletion/displacement of the equipment does not represent a specific technical constraint. The impact is considered minor.

7.2.1.3 Observations

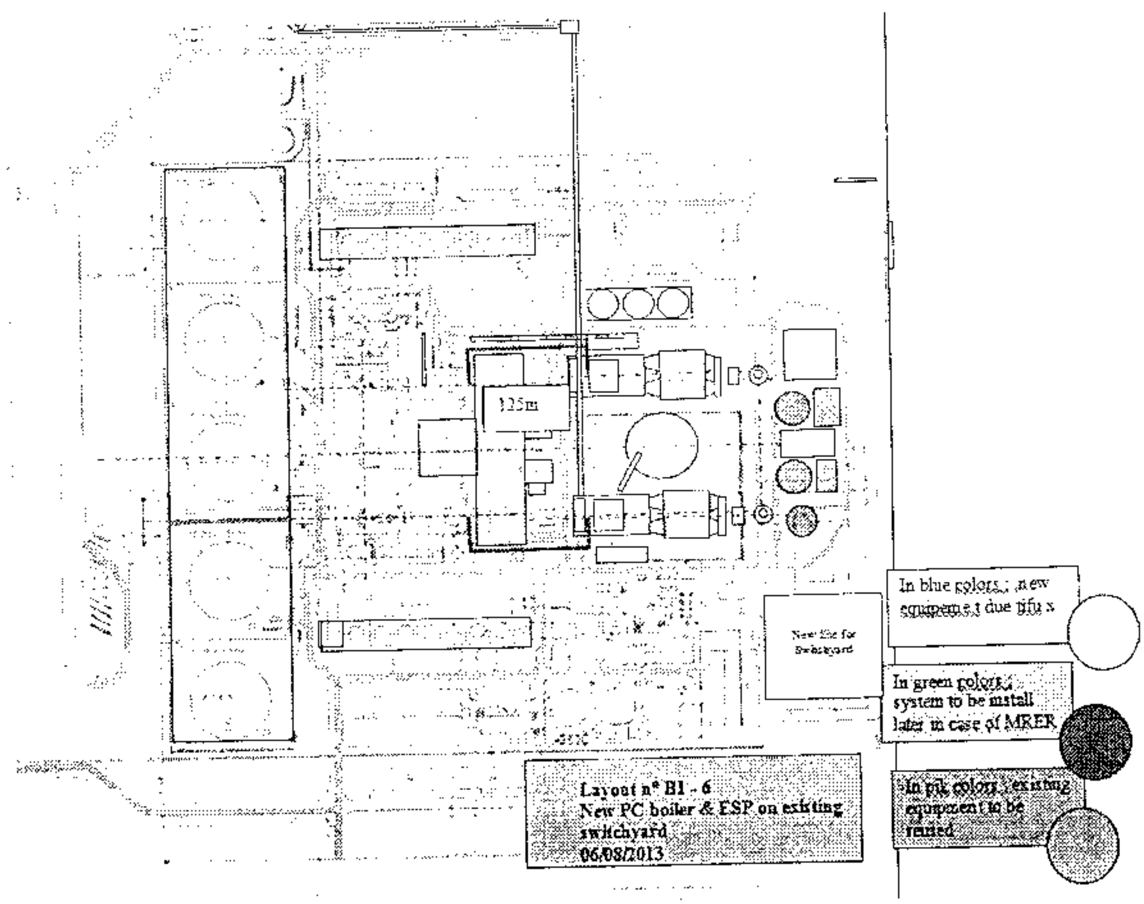
To minimize the outage period of the whole power plant during erection phase of the new project, deconstruction and erection planning shall be coordinated to ensure, during the erection of the new boilers, the supply of existing boilers with HFO from the remaining tank.

7.2.2 Solution 2

7.2.2.1 Description

Solution 2, consists to implement the new boiler on the existing switchyard area with the:

- Pond filling
- construction in more appropriate area of 2 GIS
- modification of incoming 220 kV line
- rerouting of some underground and aerial pipes and cables
- construction of new hydrogen station and underground piping rerouting
- dismantling of existing switchyard.



Solution 2

The advantage of such layout is to work after preparatory works far from the existing process system in operation during erection time.
The access to the existing boiler is preserved.

Compared to the existing situation (without considering drum height difference), new pipes rack will have an additive straight length of about 125m or about 140/150m including additional loops to insure pipe flexibility.

7.2.2.2 Preparatory works

The preparatory works of solution 2, consisting in the removal of the 220 kV switchyards, mainly require following preliminary works :

1. The construction of new Gas Insulated Substations (GIS) outside the of-way area of the new boilers, preferably between the double feeder overhead lines.
   The new GIS's will be located preferably outside the grip of the existing overhead transmission lines to avoid the constraints of working near bare voltage live parts. In addition, we must avoid straying too far from the production unit to guard against problems related to voltage drops at the auxiliary power of GIS which will be powered from the units.
   GIS building size (for a unit) is estimated at 10 m x 15 m, ie 150 m² (for memory, GIS technology allows a considerable reduction of area needed for a passage from a AIS -Air Insulated Switchyard- to a GIS. The space required for a GIS is approximately 50 times less than for a AIS).

2. The modification of the incomings of 220 kV existing overhead transmission lines to pass from aerial cable to underground cable and the whole checking procedure.
   Such works will require the construction of new overhead/underground converting towers.
   To keep the continuity of the unit's operating, such towers should be located preferably outside the grid of the existing lines but in way to avoid constraints on the existing upstream line towers. In case of excessive constraints, upstream towers should be adapted or replaced.

3. The realization of four new underground links between GSU, SUT transformers of each unit and the new GIS as well as modifications associated at the connections on the transformers.
   Potential cable routing is shown on above designed appended drawing. Measures will be taken to limit thermal influence between cable links. Underground structures to create will consist of nozzle block embedded in concrete.
   Width of such structure allowing two needed connections (GSU and SUT) will be approximately 1.6 m for each unit or, in case of common routing for both unit a total width of approximately 3.7 m.

After connexion of the existing unit to a new connections line, tests and commissioning, dismantling of existing 220 kV switchyard will be allowed.
Such works will include existing foundations demolition, rubble evacuation, and platform preparation.
The area preparatory includes also a part of the existing pond filling.
The new Gas Insulated Substations location and the boiler layout will also require:

- to move hydrogen station, new hydrogen production station will be built in an adapted area.
- to ensure rerouting of some underground pipes circuit
- potentially creating new auxiliary sources at the building housing the GIS
- adaptation of signal exchanges for the existing control and signalling means on the wall panels located in the control room

Such layout will decrease the pipe length between the boiler and the steam turbine defined for 1 layout proposal (solution 1) but, due to the transformers emplacement, the pipe length will be higher than today's pipe networks (about 80 to 150m to be confirmed on basis of the detailed study).

7.3 ANALYSIS

It has been analyzed the consequences of the distance of new boilers from the existing turbines for the two proposed layouts. These differences in both layouts are very low and impossible to detect with a warranty test because the imprecision of the measure of the coal flow. However based on technical & economical analysis among these two options, we recommend going for option 1, to install new boilers at existing HFO storage tanks area.

8 ON SITE AUXILIARY SYSTEMS LINKED TO POTENTIAL ADAPTATION

8.1 RETENTION OF EXISTING SYSTEM

Except new boiler and its associated ancillaries etc. following system can be retained and connected with new boiler with modifications and or re-routing etc.

- Raw water intake system
- BOP System
- Turbine and its associated auxiliaries
- Electrical & Instrument System other than boiler system
- Cooling tower system
- HP & LP heaters etc.

8.2 BOILER & FGD

8.2.1 Preamble & General data

It is proposed in the following chapter to focus on a new imported coal fired subcritical boiler. For all scenarios following parameters will be considered:

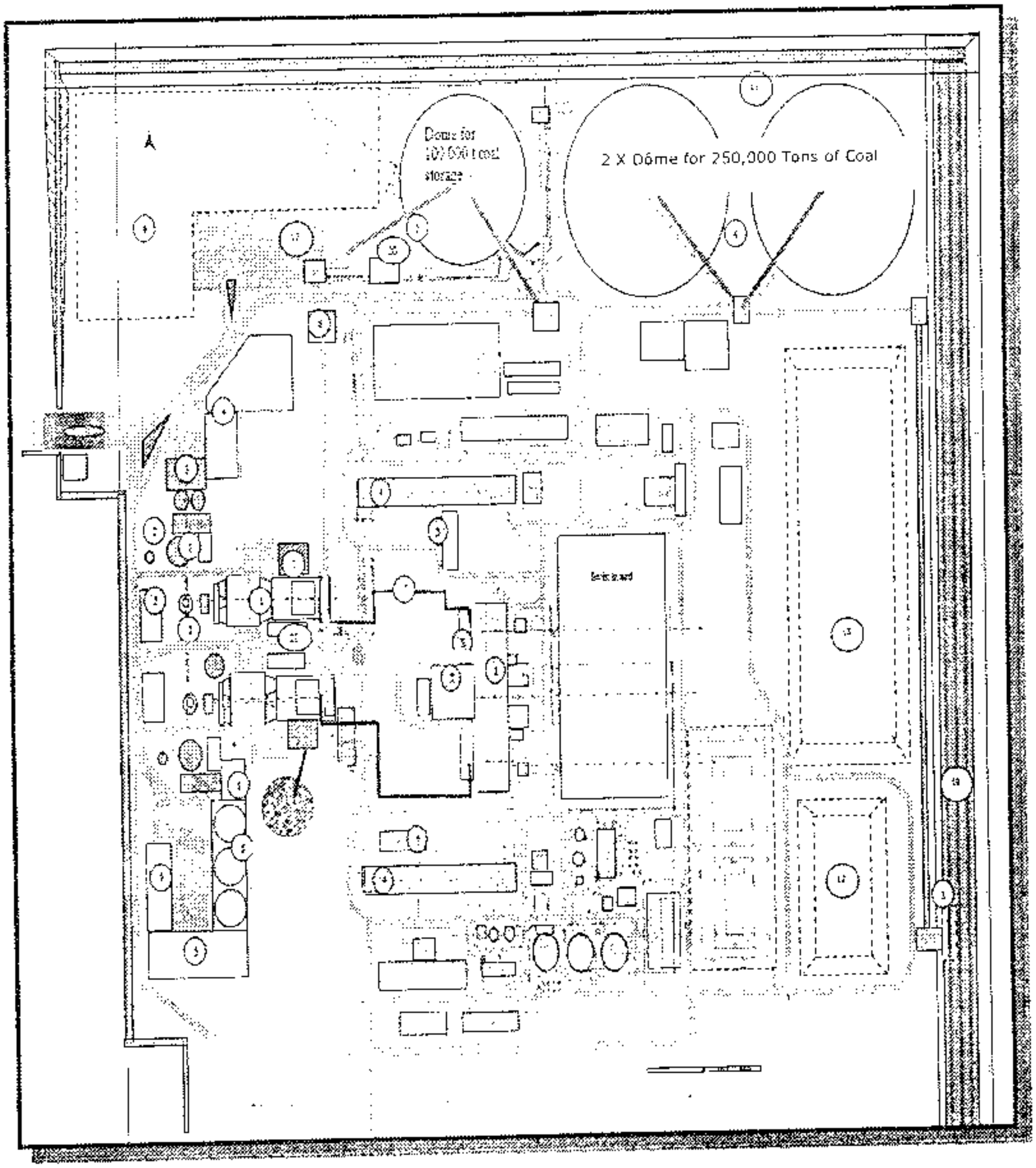
- on site storage capacity in full running days
  - solid fuel: 90 days
  - fly ash: 15 days
  - bottom ash: 15-30 days
  - limestone: 15-30 days
  - gypsum: 15-30 days
- daily open hours for bulk material delivery & evacuation
  - 6 days per week, 10 hours per day

8.2.2 Layout possibility and constraints

Few layout scenarios for the new subcritical boiler have been examined Following the economical study, choice was made for a construction in area where few HFO tanks are installed today.

Due to the needs to conserve the existing unit operating capacity, HFO storage system will be adapted prior to start erection.

Due to the length of main connecting pipes between the new boiler and the steam turbine, and keeping in mind the necessity to conserve steam characteristics at steam turbine inlet valves, it is proposed to adapt the material and diameter of feed water line, HP steam line, IP cold steam line and IP reheated steam line.
Such solution will help to minimize the required feed water pump outlet pressure and consequently to conserve the feed water system pressure design.



8.3 COAL STORAGE

A total storage capacity of about 90 days full running is requested corresponding to 600,000 tons.

Reclaiming and even stacking system for imported coal shall be redundant. Crushing capacity and coal conveyors up to boiler bunkers shall be redundant too.

As introduced in the previous chapter, climatic conditions will strongly impact coal storage design.

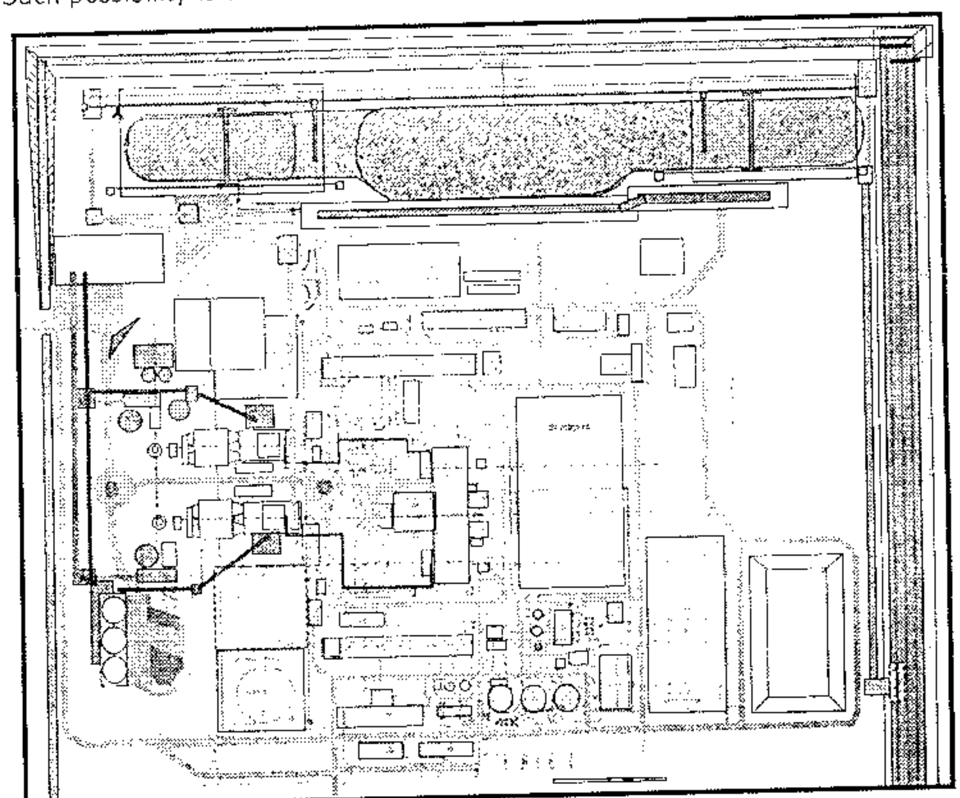
Due to the hard rain period, long dry period, strong winds, dust storm, etc outdoor coal pills will be impacted by moisture, winds erosion, sand deposits, etc...

Coal storage is also submitted to oxidation which will progressively decrease coal quality and can, if no measures are considered, ignite partial coal pile firing.

To limit in particular coal degradation by oxidation and by moisture increase of coal (excessive moisture increase should impact strongly coal handling reliability, crusher and mills reliability & capacity and unit efficiency - in first approach it can be considered that 1% of moisture increase will decrease the unit efficiency by 0.1 point), one solution consists in compacting the coal by help of bulldozers. Such compacted coal will limit oxidation and moisture on main exposed surface.

Reclaiming area will be covered to avoid water entrance inside coal handling system.

Such possibility is shown below:



This solution will not really solve coal dust flight and storage erosion in case of strong winds.

To limit the wind impact and to protect surrounding area from coal dust, it is suggested to erect covered coal storage capacity:

- two (or in case of technical constraints) three covered capacity for imported coal
- This covered storage capacity will be connected to hoppers facilities allowing coal delivery by trucks.

Such solution will ensure a better environmental preservation and is considered for total investment estimation.

8.4 ASH & GYPSUM DISPOSAL

Bottom ash will be extracted from both furnace and deposit in one area
Fly ash will be extracted from flue gas circuit low points and from ESP and send by pneumatic way to silos, prior to be wetted for storing in "disposal yard" inside power plant fences.

In case of WFGD, gypsum will be stored or in a covered area for certain duration or on specific area of above designed "disposal yard".
Storage capacity of "disposal yard" will be for at least two years autonomous.

8.5 RAIN WATER, DRAIN

The boiler area (including boilers, flue gas treatment, ash, limestone & gypsum handling & storage) and coal storage & handling area will be fitted with specific drain network to collect rain water.
That system will also collect drains from ash handling & storage (bottom ash drains, ...).
The water extracted from boiler blow down tank (one per boiler) will be sent to the existing blow down pits.

Effluents from air heater washing will be collected in a pit common to both boilers, depending of analysis; such effluents will be sent off to the existing waste water treatment plant or to a specific water treatment company.
WFGD effluents will be sent back to the existing waste water treatment.

Boiler and coal area will be equipped with settling ponds and oil separator, outlet water will be sent prior to the existing blow down tank to be recycled in process and in case of overflow to the previous designed "common clean effluent pipe".
The "common clean effluent pipe" will be connected to channel located at few hundred of meter South West from the power plant, routing will be in parallel to the existing one (which collect existing blow down pit overflow).

9 DESCRIPTION FOR NEW"ON SITE" INSTALLATIONS AND O&M ACTIVITIES

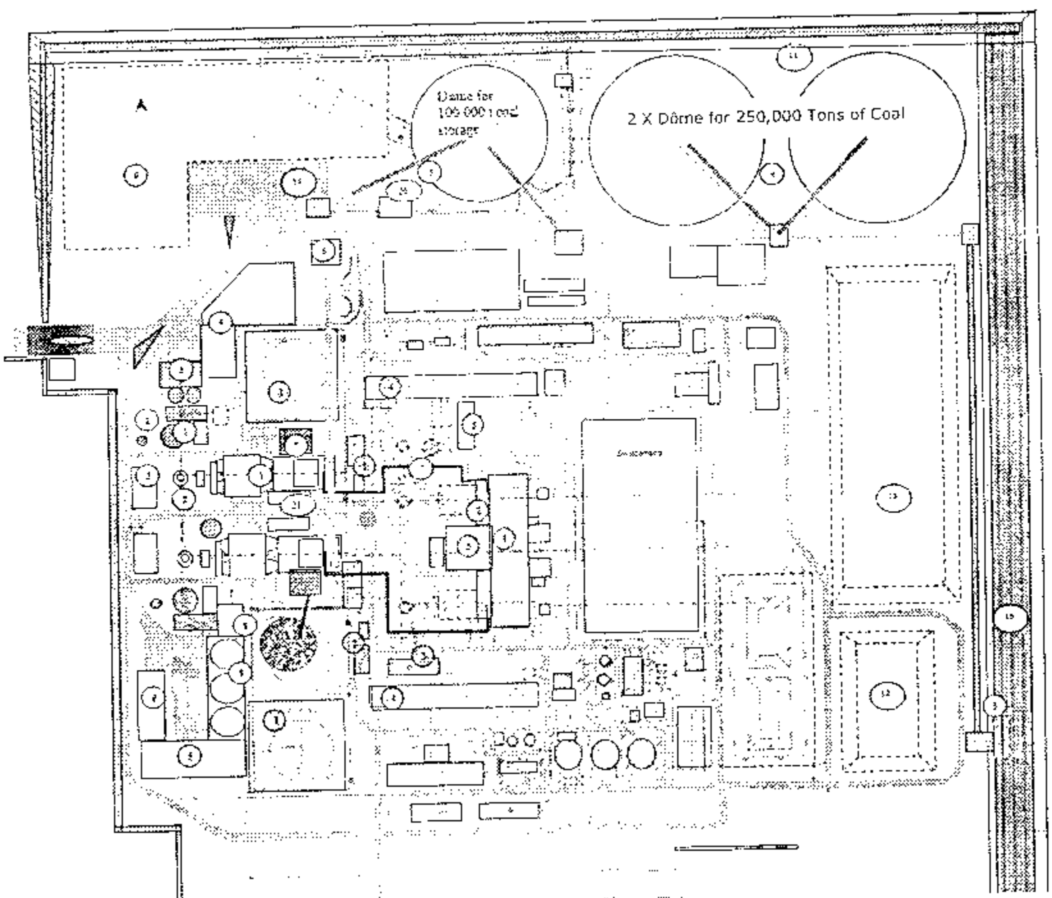
9.1 LAYOUT

The layout is presented in the both situations here after:

New system implantation before dismantling of existing equipment:

Based on solution for International coal storage can be arranged as of 2*250000t + 1*100000 t. This can be managed upward/downward according to need with EPC;

North



South

EPC Contractor will be allowed to adapt such layout according to his own studies in respect of following main points:

- Railways lines shall be erected on specific dam (Nr 10) insuring protection of power plant against floods and allowing rail lines level over foods level.

Consequently train unloading station will be located on East side of power plant.

- New dam for floods protection (Nr 11) shall be erected au North side and connected to above one and to west dam (to be extended North).
- Coal storage will be of covered type and will be divided in two parts, one of no less than 250 000 t capacity for international coal (Nr 4) exclusively and one of about 100 000 t capacity , in particular during few first year of power plant operation, international coal). Storage capacity shall be erected on North area of the power plant. Capacity allowed to domestic coal will be erected at west side of the international coal allowing coal feeding from truck unloading station.
- New Boilers & ESP will be erected on West side of the power plant, in area to be previously cleaned
- WFGD shall be installed, absorber, pumps, raw limestone storage, limestone conditioning, powdered limestone storage, slurry preparation, gypsum dehydration unit, effluent treatment station, gypsum storage capacity and slurry maintenance tank (last tank common to both unit) will be erected between today' s HFO storage area and West dam, together with fly ash silos.

  - On West Side the pond n°13 is the existing area reduced to such surface but not filled.
    The second pond (n°12) is a storm basin / polluted basin (by closing upstream valve)

  - Limestone storage and limestone conditioning workshop are designed by n°3 and 4 (green).
    One gypsum storage n° 5 (green) has a capacity of 3 months (both units running at full load with South Africa coal 1.00% sulphur).

  - Area designed by n°9 in North West corner is foreseen to store (wet) ashes and if necessary gypsum. Considering possibility to store bulk ash/gypsum on 6 meter height, allowed area should allow two years of operation with international coal.

9.2 DESIGN DATA

9.2.1 Boiler(s)

The design data are listed (including WFGD for information) with imported south African coal:

- Gross power 362MW for LalPir & 365 MW for Pak Gen
- Boiler efficiency at least 88%
- Auxiliaries' consumption with WFGD: about 9% which is around 32~33 MWhe
- Boiler steam characteristics
  - HP Steam flow : 1130 t/h
  - HP steam pressure & temperature (downstream super heater) (to be confirm by EPC Contractor in respect with steam turbine data and feed water system design
  - IP steam pressure and temperature downstream reheat exchanger: (to be confirm by EPC Contractor) :

- Imported coal flow approx. 2*136 t/h

9.2.2 Flue Gas Cleaning

In order to comply with the required limits of atmospheric emissions and specific power plant management concerning NOx, it is planned to install :

- low NOx burner and additional primary deNOx system (OFA, ...)
- ESP to ensure 50 mg/Nm^3
- WFGD downstream of ESP

The rated capacity of the limestone = 4.0 to 4.5t/h per unit.

9.2.3 Coal supply

As stated in this study, the coal will be delivered by railway.
Unloading capacity will be 5 to 6 trains per day (Assuming train net capacity of 1500 tonnes for 25 wagons hopper 60 t with bottom doors). The granulometry of the delivered coal will be 0-50 mm.

9.2.4 Delivery & evacuation of flue gas treatment by-products

The limestone will be delivered from the production site by truck
The gypsum will be evacuated by truck.
On the basis of the foregoing, the following daily frequencies of rotation of (100 tonne capacity) lorries may be estimated, six days a week.

9.2.5 Electricity, I&C and ancillaries

9.2.5.1 Electricity

The scope of work includes, for each production unit:

- check the dimensioning of the existing electrical equipment from the connection point of unit auxiliaries transformer on the 24 kV generator/step-up transformer bus duct, on the one hand, and from the 220 kV switchgear of the start-up transformer, on the other hand.

- if the results of power balance deemed it necessary, replacement of equipment located downstream the points defined before. These include, without limitation:

    - the 24 kV bus duct connection for supply of unit auxiliary transformer (UAT),
    - the unit auxiliary transformer (UAT),
    - the bus duct link between the unit auxiliary transformer (UAT), and the 11 kV main switchboard,
    - the start-up transformer (SUT),
    - the 11 kV bus duct link between start-up transformer(SUT) and 11 kV main switchboard.

- a new 11 kV boiler switchboard located in the new boiler building and supplied by two feeders (normal/backup) from the existing 11 kV main switchboards. This switchboard will supply:
    - the MV consumers of the new boiler and its auxiliaries,
    - the MV/LV transformers necessary for the supply of the LV consumers of the boiler and his auxiliaries,
    - the coal yard HV/LV substation.
- the extension of the existing 11 kV main switchboards by two switchgear cells for the feeding of the new 11 kV boiler switchboard.
- the MV/LV transformers.
- the MCC 400 V switchboards.
- auxiliary sources distribution switchboards for instrumentation and control of the new facilities. These switchboards will be supplied from the existing sources switchboards.
- the lighting, outlets and HVAC distribution switchboards.
- the whole MV/LV wiring associated to the new boiler, its auxiliaries, the coal yard and the different equipments etc.
- the grounding network of the new boiler and its interconnection with the existing network.

9.2.5.2 I&C

New boiler, solid fuel and ash handling system shall have their own control system (including BPS, BMS and ESD systems).

New boiler and solid handling facilities control system shall be able to work in standalone mode independently of the existing system in particular to allow the boiler testing without disturbing the operation of existing units.

Existing HMI has to be adapted with the new boiler mimics (also coal handling mimics). There should be no specific boiler control logic integrated in existing DCS system (only data exchange and read/write routines for tracking values).

In order to limit as much as possible adaptations and modification in existing DCS (if possible, otherwise based on EPC study it would be replaced with new DCS for whole plant). The specific control system (boiler, coal & ash handling) will be implanted in specific automation rooms in or near the boiler building and according to layout close to coal storage area.

9.3 AREA PREPARATION WORKS

Before boiler erection in the HFO tank area, the required HFO tanks Nr 2, 3 & 4 has to be dismantled.

9.4 MAIN NEW EQUIPMENTS AND SYSTEMS

9.4.1 The new PC boiler (for each unit)

9.4.1.1 Coal preparation and firing system for direct firing

The system will be completed with:

- Raw coal daily bunker (or silos) with level and weight measurement.
- Permanent facility of bunker emptying chute to enable unloading of bunkers on trucks at ground level.
- Coal chute between bunker shutoff gate and RC feeder inlet with motor operated (sliding gate type) raw coal bunker shut off gate at the bunker mouth and manually operated gate at RC feeder inlet (both shall be for each coal feeder). Each line shall also include chain wheel and chain for manual operation of bunker shut off gate and RC feeder inlet valve from the feeder floor.
- Gravimetric raw coal feeders with microprocessor based precision weighing and calibration device.
- Coal chute between outlet of feeder and inlet of mill along with motor/pneumatic operated shut off gate at RC feeder outlet.
- Coal pulverisers complete with all wear parts, grinding elements, classifier, lubrication systems (redundant lube oil pumps, redundant cooler, at least redundant filter, vents, etc.).
- Primary air fans and seal air fans.
- Pulverised fuel (PF) pipes and ceramic lining.
- Low NOx burners PF burners and burner wind box.
- Coal burners tilt drives (if applicable) with linkages and complete actuator assemblies, air registers, igniters, scanners, scanner fans, etc. as required.
- All needed auxiliary system including required cooling system, coal sampling system, ...
- All local and remote instrumentation for local and "in control room" information, for coal feeding control, for safety like eg daily silo level measurements, devices to detect choking/flow/no flow of coal in the coal chute between coal bunker and RC feeder, switches to detect presence or absence of coal on feeder or choking of feeder, adequate number of temperature sensors signalling contacts for pulverized bearings and lube oil systems.
- Proven fire detection and fire extinguishing systems.

The burners' box will also include low fuel oil burners (for ignition and to ensure coal combustion stability at low load), all connections and valves between burners and low oil distribution system.

One Portable lubricating oil purification plant for pulverisers' maintenance will be provided complete with tank, pumps, purifiers, piping, valves fittings and local instruments and control panels. This oil purification system will be common to both units.

9.4.1.2 Air and flue gas system

- Primary air fan(s).
- Secondary air fan(s).
- ID Fans.
- Service or cooling air fan(s).
- Steam air heater including sub cooling area with steam connexion, condensate extraction and systems allowing condensate transfer to deaerator.
- Primary, secondary, tertiary and cooling air distribution networks.
- The flue gas circuit including fly ash hoppers.
- All inspection traps, man holes.
- All instrumentation.
- Two regenerative tri-sector air pre-heaters (APHs) complete with (but not limited to):
  - externally adjustable seals of easily replaceable type.
  - air heater thermal exchange elements arranged in baskets easily removable in groups/baskets for maintenance.
  - permanent fire fighting equipment on both gas as well as air sides and also on both cold as well as hot end sides including, spray nozzles, valves and pipe work and connection to fire water system Dust hoppers with ash level indicators etc.
  - bracing, stiffeners, supporting structure, baffles, access door, mating flanges, expansion joints.
  - off load water washing facility along with water piping and connection to concerned network and drainage piping to retention pond (including pumps and downstream needed connexion for effluents transfer or to truck for evacuation existing or to water treatment unit).

  - the drive system shall consist in particular of:
    - a peripheral AC drive connected to drive air heater along with automatic clutching/declutching arrangement.
    - an independent air motor drive along with automatic clutching / declutching arrangement. And air receiver with sufficient storage capacity.
  - the lubrication system with at least redundant oil pumps, redundant coolers, redundant filters (with differential pressure switches), oil storage tank retention, instrumentation, piping, valves differential pressure switches, pressure relief valves, non return valves, electrical/ pneumatic actuators with all accessories.
  - alarms for failure of drives and lubrication system.
  - all needed instrumentation for exploitation, safety and integrity.
  - facilities along with the grids for flue gas sampling and gas temperature measurement on both the inlet and outlet sides of APH.

- observation ports with vapour proof light for internal inspection (rotor, etc).
- maintenance and access facilities.

Primary air fans, secondary air fans and ID Fans will of axial or radial type with constant speed motor with variable pitch controller and shall be provided with bearing lubrication and hydraulic blade pitch control unit consisting of redundant oil pumps, redundant coolers, redundant filters (with differential pressure switches), oil storage tank retention, instrumentation, piping, valves differential pressure switches, pressure relief valves, non return valves, electrical/ pneumatic actuators with all accessories.

Silencers shall be provided at the suction of the fans to limit the noise levels to specified values.

9.4.1.3 The water / steam system of steam generator

- Drum with internals, mounting and fittings (safety valves for overpressure protection, internal primary and secondary separators, blow down system, etc).
- Water cooled furnace complete with furnace bottom hoppers, drains etc.
- Vaporizing parts.
- Superheaters including safety valves, drains, start-up vents, air release valves, nitrogen.
- Reheaters including safety valves, drains, start-up vents, air release valves, sampling.
- Connections, sampling connections etc.
- Superheater and reheater desuperheating spray systems.
- Integral piping, valves and associated fittings.
- Main steam stop valves including integral bypass valves on each main steam line.
- Boiler outlet completed with their motor drives and control equipment.
- Economizer with recirculation piping (as required), vents, drains and sampling connections etc.
- The safety valve downstream of superheaters, boiler vent, connection to soot blower circuits.
- All needed drain pots, bypass (e.g.: to avoid vaporizing in economiser part).
- Boiler blow down tank with all connections and cooling water make up and spraying system (including control valve).
- All connection for chemical product injection.
- All insulation, cladding of the different system.
- All needed instrumentation.
- Etc.

9.4.1.4 Other

- The soot blowing system.
- All access platform, staircases and (for insuring escape) ladders.
- All needed lifting equipment.
- The boiler steel structure including all needed support for above listed items and boiler roofs and cladding an upper part, staircase and critical areas.
- instrumentation needed for operation, equipment integrity requirements, reliability and personnel safety will be provided

- Safety purpose will in particular concern excessive temperature, excessive level, mechanical breaks, and transmitter's discordances).

9.4.2 Flue gas cleaning system, stack & monitoring (for each unit)

9.4.2.1 ESP

Boiler flue gas duct shall be connected, downstream of boiler, to an electrostatic precipitators shall be electrically independent (including transformers, rapping and control).

Internal of electrostatic precipitators will consist of:

- emissive electrodes,
- collecting electrodes,
- shocking devices for emissive electrodes,
- shocking devices for collecting electrodes,
- internal access.

Electrical supply of each field will be independent of other one (including shocking function).

All access inside electrostatic precipitator shall be interlocked with corresponding electrical fielding equipment.

Ash collecting hopper under electrostatics precipitator shall be connected to fly ash collecting system to ensure ash removal and transport to fly ash silos.

Downstream of electrostatic precipitators, duct shall be connected to ID fan(s) itself connected to the unit stack and to WFGD.

9.4.2.2 WFGD

The desulphurisation unit will have, in particular:

- The absorber and its auxiliary equipment:
  - the absorber whose characteristics must be specified in the Contractor's tender,
  - the devices for admitting, guiding and homogenising the flue gases,
  - the demister,
  - the circuits for recirculating the washing solution,
  - the devices maintaining the homogeneity of the suspension in the absorber tank,
  - the "unit" oxidising the solution with, if necessary, the air cooling systems, and the systems for cleaning or washing the filters on the air admission,
  - the circuits for extracting and evacuating "drained fluid" to the dehydrating unit,
  - the droplet washing and reserve water circuits with, where applicable, the buffer reservoir/s,
  - the inlet/s of fresh solution,
  - the admission/s of filtrates,

- the safety devices and those for preserving the lifetime of the absorber in particular in the event of an abrupt lack of water or electricity ("black out"),
- the devices protecting against excess pressure and negative pressure,
- the anti-clogging devices.

➢ The receipt, storage and reagent preparation plant – par common to both unit (but with required redundancy):

- a unit for filling and storage of raw limestone,
- a system for extracting and transporting raw limestone to the crushing or breaking + crushing unit,
- the complete crushing unit whose dry or wet principle must be justified and described by the Contractor in his tender) showing in part the devices for classification and recycling at the head of the crusher, and in the event of dry crushing, the system for prior drying of limestone and in the event of wet crushing the water inlet circuit.

The limestone processing and supply installation mainly consists of :

➢ A covered store on the ground (to limit the humidity of the limestone)
➢ Machinery (on pneumatic tyres) for collecting stock and loading it onto conveyor belts.
➢ Two limestone grinding and drying installations
➢ A circuit for transporting the ground limestone to the storage silo of the limestone preparation unit.

The limestone storage area must be able to guarantee the power station autonomy in the event of a problem with the lorries that bring the crude limestone. A capacity of 7 days should enable such problems to be overcome. Provision must therefore be made for a stock of 450 t, that is, 380 m^3. In order to limit the water content of the crude limestone, this stock will have to be covered.
The lorries will discharge the limestone onto an area adjoining the store. The limestone will then be picked up by a loader on tyres, to be stored. This loader will collect the limestone in order to load it onto a hopper at the grinding plant.

This plant will ensure drying and reduction of the grain size to a few tens of microns.

The limestone thus prepared will be sent by wheeled transport to the limestone silo of the lime wash preparation unit.

➢ The receipt, storage and reagent preparation plant – par specific to each unit:

- storage silos crushed reagent equipped with admission, extraction and reagent drainage devices, systems for admission and extraction of air, dust-removal devices, devices preventing the entrance of humidity, any devices or excess pressure,
- the filling station (with flexible hoses and connection) one unit of which will be equipped with a full air compression unit necessary for this operation for filling and transferring reagent to the silos,

- the devices for extracting and transporting limestone to the preparation unit with, where applicable, the air compression unit or units, and those for complete transfer (with cooling, drying, filtration, oil separation, etc.),
- the fully equipped tank/s for preparing the solution (devices for agitation, reheating if necessary, admission of water, admission of filtrate, etc.),
- water circuit distribution,
- the circuit for extracting and transferring the solution.

➢ Gypsum preparation plant including in particular the hydrocyclones responsible for the separation and initial thickening of the gypsum, and as necessary additional conditioning system to produce gypsum quality in accordance with Pakistan regulations.

➢ Gypsum storage: gypsum will be stored on covered area common to both unit allowing truck loading. Gypsum will be send by truck to disposal located outside from the power plant.

➢ Collecting drips, overflow, drains:

- the various collection basins (or pumping up pit) in particular:
  - the absorber catchment basin,
  - the pit for collecting drips, filters, drained fluid... from the dehydration room,
  - the pit or pits for collecting washing water from the fuel filling or truck loading zones,
  - more specifically these basins and pits must be equipped with the necessary agitators and lift pumps.
- the circuits for distributing these effluents towards, depending on the quality of effluent, either the filtrate tank or the absorber or the water treatment unit.

➢ Effluents treatment plan:

Purge from the desulphurisation plant will be necessary to control the chlorine content of the solution (coming from the chlorine contained in the fuel).
According to gypsum quality allowed by law, specific blow down will be needed.
Two possibilities to manage such effluent are:

- To inject the effluents inside flue gas for evaporation (risk link to such process should be analysed during detailed study)
- To ensure treatment in adapted treatment plant

➢ One maintenance tank common to both unit with all needed transfer pumps, agitators, instrumentation, piping, valve, etc.

9.4.2.3 Stack

It has been decided to keep stack solution open within a proposed investment.

9.4.2.4 Monitoring

Stack will be equipped with following probes connected to analysers for SOx, NOx, CO, O2 analysis, dust concentration measurement, a flue gas flow meter with temperature correction.

All analysers will be installed in a specific shelter (container) fitted with air conditioning and located close to the stack.

Sampling holes with flanges shall be implemented at required high to allow insertion of probes for sampling and tests.

10 INVESTMENT - ECONOMICAL ANALYSIS

10.1 MAIN INLET PARAMETERS

10.1.1 Basic running conditions

Today, it can be considered, due to lack of Pakistan generating capacity that both units will run on base load mode with:

- An average running factor estimated to 85%.

10.1.2 Fuel characteristics

Designation	Unit	Imported coal	Local coal
LHV	BTU/kg	23,611	22,046

10.1.3 Equity, interest rate & debt period

For on-site construction :

- equity: 25 % of investment
- debt: 75 % of investment
- debt period : 10 years
- interest rate: Libor +4.5% for foreign Loans & KIBOR + 2.0% for local loans
- insurance rate: 1 %
- Project Life: 30 Years
- ROE: 24.5 %

10.1.4 Installation & Outage duration

The project will be installed in 30 months and it will require a 6 months of outage duration for interconnection with existing system as per below detail:

- Installation of new boiler: 30 months
- Connection & Commissioning: 6 months

Total Time for installation of new boiler and interconnection: 36 months

10.2 ECONOMICAL CALCULATION

The Coal Conversion consists in new subcritical boilers with use of imported coal and WFGD.

The design data are listed with imported South African coal:

- Gross Power LP:362MW & PG: 365 MW
- Boiler efficiency atleast 88 %
- Auxiliaries' consumption 9% about 32~33 MWhe
- The rated capacity of the limestone 4.0 to 4.5t/h per unit
- Boiler steam characteristics
  - HP Steam flow : 1130 t/h
  - HP steam pressure & temperature (downstream super heater) (to be confirm by EPC Contractor in respect with steam turbine data and feed water system design
  - IP steam pressure and temperature downstream reheat exchanger: (to be confirm by EPC Contractor) : bar / °C
- Imported coal flow approx. 2*136 t/h

10.2.1 Technical characteristics

For Coal Conversion	Units	LalPir Unit	PakGen Unit	For both Units
Generator nominal output	MWe	362	365	727
net power at full load	Mwe	329.42	332.15	661.57
ratio auxiliaries / gross power	%	9.0	9.0	9.0
solid fuel consumption at full load	t/h	135.3	136.4	271.7

10.2.2 Estimated EPC project cost with break-up

Boilers and direct auxiliaries (primary & secondary air fans, IDFans, coal silo, mills, PC distribution circuit, HSD distribution circuit, burners, bottom ash extraction, sampling and chemical dosing, piping rack):	US$ 181 MM
Coal unloading, storage and handling /ash handling and storage:	US$ 95 MM
Electricity & I&C:	US$ 38 MM
Civil works, buildings, additional roads & fences, ground preparation:	US$ 50 MM
Flue gas treatment to reach environmental requirements:	US$ 50 MM
Contingency :	US$ 25 MM
Total	US$ 439 MM

10.2.3 TOTAL CAPEX

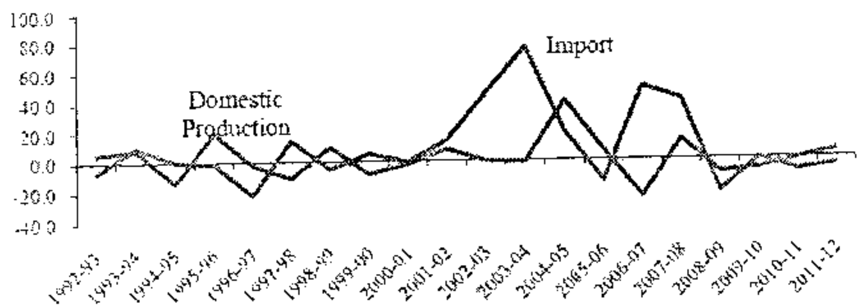
Investment level prior financing cost					
Scenarios designation	on site	for transport facilities	total for one unit	total for 2 units	total investment per installed power
	US$ MM	US$ MM	US$ MM	US$ MM	Million$/MW
Coal Conversion	439	Not applicable	439	878	1.20

11 FUEL OPPORTUNITIES

11.1 INTRODUCTION TO PAKISTAN COAL STORY

As described in the following paragraphs concerning local coal, Pakistan has huge coal resources estimated at over 186 billion tonnes; including 175 billion tonnes, identified at Thar coalfields.
Pakistan's coal generally ranks from lignite to sub-bituminous.
Despite large coal resources, constraint linked to the domestic transport and coal characteristics not adapted to some process requirements, Pakistan imports a part of consumed coal.
Today, almost 4 million tons of coal is imported.

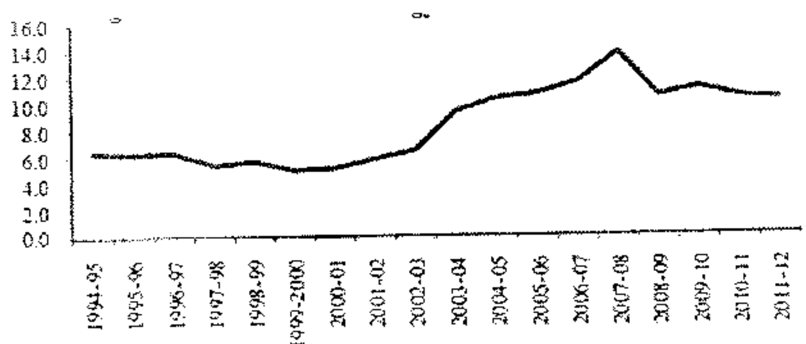
Growth in Coal Supply



Source: Hydrocarbon Development Institute of Pakistan

It can be seen from the above figure that on average import of coal remained more than domestic production which support the claim that domestic resource is of inferior quality having low BTU and it is better to import rather than processing it because of high cost.
However, share of coal in energy has started declining since 2007-08 as shown below:

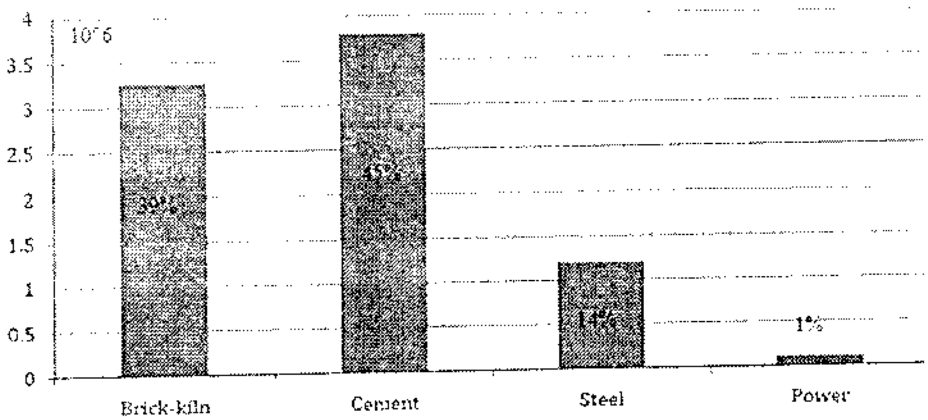
Share of Coal in Energy (%)



Source: Hydrocarbon Development Institute of Pakistan

Today, for electricity generating, the coal consumption is limited. The major users of coal are the cement sector and brick kilns; about 58 percent of the total coal was consumed by cement while 41 percent was consumed by the brick kiln industry during 2012.

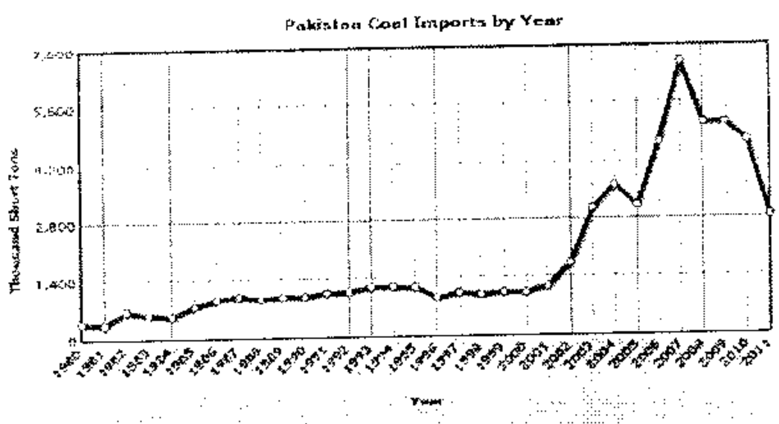
In 2008, the repartition of coal per activities was quiet similar as shown below (consumption in Millions tonnes):



One Coal fired power plant is located in Sindh Province, commissioned in 1995, Lakhra power plant include 3 CFB Unit of 50MWe each using high suflur contain local coal from Lakhra mine. Today, Lakhra power plant has been derated and seems to be strongly impacted by technical and coal quality troubles.

Coal Import Statistics

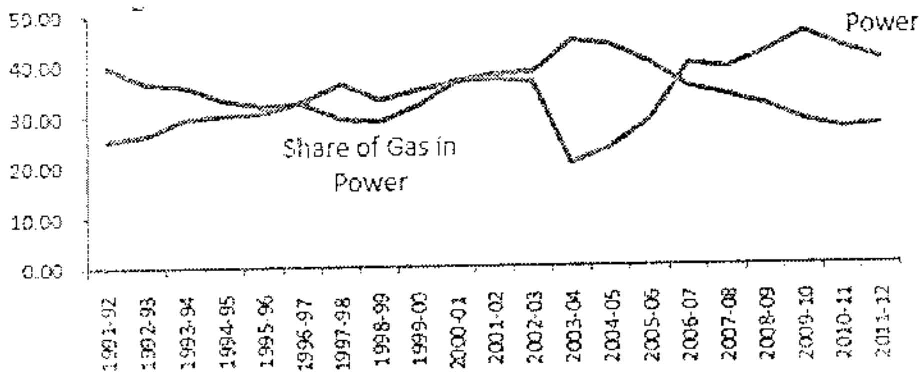
Year-wise import of coal in Pakistan is given below



Source: United States Energy Information Administration

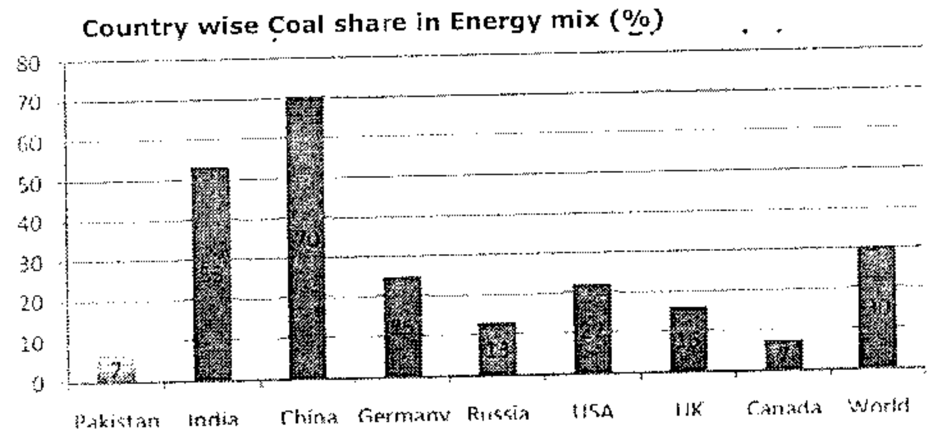
In comparison, HFO and natural gas take a higher part in Pakistan Power Mix as shown below:

Share of Oil and Gas in Power



Source: Hydrocarbon Development Institute of Pakistan and EA

Pakistan energy mix is characterised by a reduce share of coal (imported coal and domestic coal) in particular in comparison with India, China as shown below:



Source:BP Statistical Review of World Energy June 2012

11.2 SHORT INTRODUCTION TO MAIN COAL TYPES

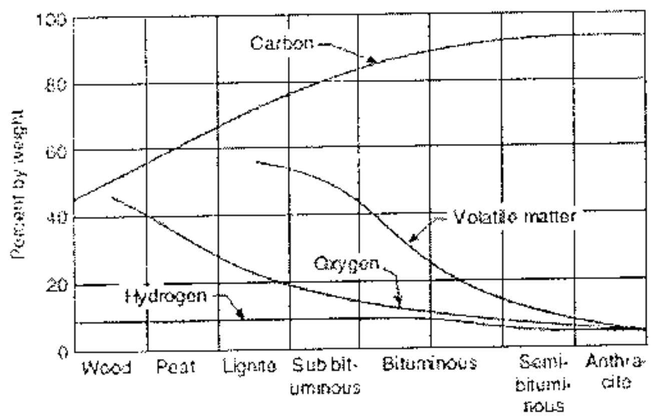
The coal was formed from prehistoric plants, in marshy environments, some tens or hundreds of millions of years ago.

The presence of water restricted the supply of oxygen and allowed thermal and bacterial decomposition of plant material to take place, instead of the completion of the carbon cycle. Under these conditions of anaerobic decay, in the so-called biochemical stage of coal formation, a carbon-rich material called *peat* was formed.
In the subsequent geochemical stage, the different time-temperature histories led to the formation of coals of widely differing properties, as summarized below table:

Carbon content and age of different coals:

Coal type	Approximate age (years)	Approximate carbon content, %
Lignites	60,000,000	65-72
Sub-bituminous coals	100,000,000	72-76
Bituminous coals	300,000,000	76-90
Anthracites	350,000,000	90-95

The below figures give a view of the progressive change during coal formation (from wood up to anthracite and under other form from lignite up to anthracite)

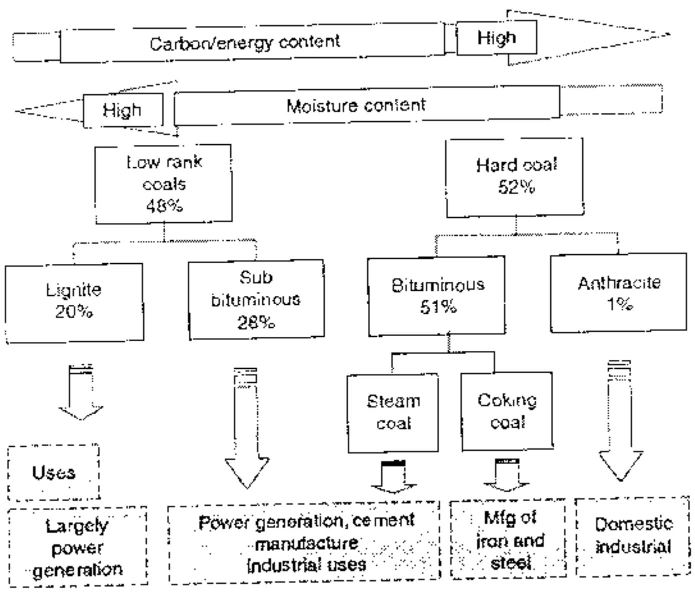


	<------- Low Rank	-------><-----	High Rank	------->
Rank:	Lignite	Subbituminous	Bituminous	Anthracite
Age:	------------------	increases	------------------	>
% Carbon:	65-72	72-76	76-90	90-95
% Hydrogen:	~5 ------------	decreases	------------	~2
% Nitrogen:	<------------	~1-2	------------	>
% Oxygen:	~30 ------------	decreases	------------	~1
% Sulfur:	~0 ------ increases	------ ~4	--- decreases ---	~0
%Water:	70-30	30-10	10-5	~5
Heating value (BTU/lb):	~7000	~10.000	12,000~15,000	~15.000
MJ/kh :	16.3	23.3	27.9 - 34.9	34.9
MWh/t :	4.5	6.5	7.8 - 9.7	9.7

Based on few samples analysis from literature, the below table gives an estimation of H_2O, C, H, N & O evolution

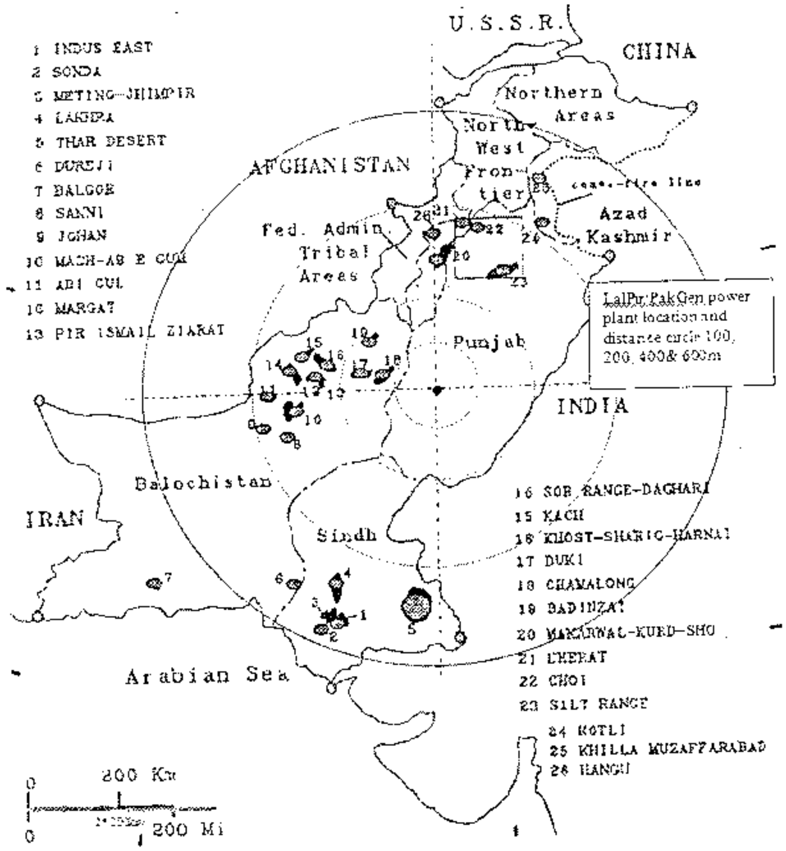
Fuel	Moisture in % (at 40°C in air dried sample)	Main chemical composition			
		C (%)	H (%)	N (%)	O (%)
Wood	25	50	6.0	0.5	43.5
Peat	25	57	5.7	2.0	35.3
Lignite	20	67	5.0	1.5	26.5
Sub Sub-bituminous coal	11	77	5.0	1.8	16.2
Sub-bituminous coal	4	83	5.0	2.0	10.0
Semi - bituminous coal	1	90	4.5	1.5	4.0
Anthracite	1.5 (lowest)	93	3.0	0.7	3.0

The following figure gives an approach of the coal rank and coal qualification evolution:



11.3 LOCAL COAL

There are vast resources of coal in all Pakistan's provinces as shown on the following maps locations and names of major coalfields and coal occurrences of Pakistan.



Location of Pakistan coal fields and occurrences - Modified from Scheinfurth & Hussain, 1988

But, due to, on one hand, the high distance between mines and power plant site, and, on the other hand, the coal/lignite characteristics (low heat value increasing need coal flow and consequently number of trains required for transport, high content of moisture or of O2, high level of volatile matter increasing coal degradation risk during transport and storage), the use of coal/lignite from Sindh and even Punjab are not be considered.

In Pakistan, LCV of coal other than Thar is as follows:

Balochistan	
Khost/Sharig	9,637-15,499 BTUs/Lb
Sorange-Degari	11,245-13,900 BTUs/Lb
Dukki	10,131-14,164 BTUs/Lb
Mach	11,110-12,937 BTUs/Lb
Punjab	
Salt Range	9,472-15,801 BTUs/Lb
Khyber PakhtoonKhwa	
Hangu Orakzai	10,500-14,149 BTUs/Lb

Source: Geological Survey of Pakistan

11.4 INTERNATIONAL COAL

Following are some of the world's largest coal exporters:

World Top Coal Exporters (2012)	
Country	**Coal Exports (Million Tons)**
Indonesia	383
Australia	301
Russia	134
USA	114
Columbia	82
South Africa	74
Canada	35

Nevertheless, we want to point out that it should be necessary to enlarge the range of the coal characteristics in order to guarantee the good operation, in particular, increasing the range of the two elements like water and ashes.

The plant is feasible to design on average imported sub bituminous coal properties of at least three main exporters to overcome the any unforeseen situation in any one country.

Data sheets from few coals are appended to present report.

The below table gives ultimate analysis of few South Africa coal

South Africa Coal							
		0	1	2	3	4	5
Volatile matters	%	23,3	23,02	22,82	23,65	25,91	23,89
H2O	%	9	8,3	8	7,6	9,1	8,8
Ash	%	14,01	13,94	14,35	14,23	13,09	13,41
C	%	64,79	65,2	65,86	65,78	64,08	64,33
H	%	3,55	3,60	3,46	3,59	3,64	3,57
N	%	1,55	2,51	1,57	1,72	1,82	1,53
Cl	%	0,01	0,02	0,02	0,01	0,01	0,00
O & other	%	6,55	6,21	6,58	6,89	7,95	8,19
	%	100,0	100,0	100,0	100,0	100,0	100,0
LHV	Btu/lb		10738	10728	10906	10760	10696

- Solid fuel main characteristics :

Designation	Unit	Imported coal	Local coal
LHV	BTU/kg	23,611	22,046
Ash	%-as received	14.01	11
Moisture	%-as received	9	11.4
Sulphur	%-as received	1.0	3.05

12 FACILITIES NEEDED FOR SOLID FUELS DELIVERY TO SITE (RECEIPT AND TRANSPORT)

12.1 SEAPORTS

12.1.1 General

Pakistan shares a 1,046 kilometers long coast line with the Arabian Sea - amid sea which joins the strategic oil line of Persian Gulf with the Indian Ocean.
On it lie three major Sea Port:

- Karachi Port, the oldest major port has been serving this part of the erstwhile Indian subcontinent and later Pakistan on its creation in 1947.
- Bin Qasim Port distant by few km from Karachi port.
- Gwadar Port

Karachi Port and Port Qasim are close from main Pakistan railways axes. Study has focus of this two sea ports.

Karachi Port is managed by the Karachi Port Trust (KPT), while Port Qasim is managed by the Port Qasim Authority (PQA).
Both the ports have the facility to handle fuel oil as well as coal.

12.1.2 Karachi Port Trust

KPT is the main port that deals with the imports and exports of liquid bulk cargo and dry bulk cargo. KPT handled the imports of bulk liquid cargo of about 9.84 million tonnes in the year 2009-10. The imports of crude oil, diesel and furnace oil handled by the port in the year 2009-10 were 6.12 millions tonnes, 0.6 million tonnes and 1.17 million tonnes respectively.

Currently KPT has the capacity of 24 million tonnes to handle all types of fuels. However, currently the capacity of KPT to handle liquid cargo is under-utilized and less than half of the available capacity is being used. KPT has plans to increase the fuel handling capacity to 28 million tonnes per annum in the future, however considering that its present capacity is under-utilized; there are no plans to enhance this capacity significantly. KPT also has the storage capacity of 1 million tonnes for the liquid fuel. There are no plans to increase this storage capacity.
As regards the handling of coal, KPT has handled the import of 3.65 million tonnes of coal in the year 2009-10. The available capacity to handle coal is 4 million tonnes per annum.
It has no plans to enhance this capacity as Port Qasim Jetty will be utilized for coal handling.
KPT also has the storage facility for coal available at the port, which is 0.7 million tonnes.
As regards the future development projects relevant to fuel logistics, KPT has signed a MOU with PSO for laying the fuel oil pipeline from Keamari to Korangi.

12.1.3 Port Qasim Authority

Port Qasim is the second busiest port in the country and handles about 40% of the nation's cargo (17 million tonnes per year). It is located near Karachi at a distance of 35 km from the city centre.

At Port Qasim, the terminal that deals with the handling of fuel oil is FOTCO (Fauji Oil Terminal and Distribution Company). It was the first terminal to be developed by the private sector on BOO basis at a cost of US $ 87 million. The terminal is operational since April 1995. It is capable of handling 9 million tonnes of furnace oil per annum (750,000 tonnes per month) with a growth potential to handle more than 27 million tonnes with three additional berths. HSD and crude oil are also imported at FOTCO terminal after commissioning of the PAPCO oil pipeline.

The facility mainly comprises a jetty capable of handling up to 75,000 DWT vessels, product pipelines, loading arms and a 4 km long trestle that connects the jetty with the shore. The terminal has the capability to berth tankers with 63,000 tonnes ship-load. It also commenced handling white oil from January 2001 through a separate 30 inch diameter pipeline. For liquid fuel storage, 77 acres of land has been earmarked.

FOTCO has a capacity to handle 15 tankers per month. Infrastructure limitations of FOTCO restrict the large size vessels. However, due to inadequate port and storage facilities at other terminals belonging to KPT and PQA, it is expected that 20-23 cargoes per month will be handled at FOTCO which will result in congestion at the FOTCO terminal.
The terminal is designed to cater for four additional berths and four product pipelines to meet the current and future fuel handling requirements of the country.

There is a separate Iron Ore and Coal berth that deals with the imports of coal. The Iron Ore and Coal berth commissioned in 1980 is a specialized berth for handling Iron Ore, Coal &Manganese for Pakistan Steel Mills. The design capacity of the berth is 3.36 million tonnes per annum. The berth has a handling capacity of 1400 tonnes per hour. Currently vessels of 55,000 tonnes payload are being handled here. The berth is connected to the Pakistan Steel Stockyard through a 4.5-kilometer long conveyer.

PQA has developed plans to increase port parameters to accommodate larger vessels to benefit from economy of scales, strengthen the port with requisite crafts and build additional berths/terminal for capacity enhancement. Some of the development projects relevant to the fuel handling include establishment of LPG terminal and Coal & Clinker/cement Terminal.

The volume of wheat to be handled at Qasim port in 2024/25 is estimated as 17.1 million tons.

At present, Marginal Wharf Berth Nos. 2-4 are handling wheat and the handling productivity is rather high at about 120 tons per hour, which seems to be a result of good management/operation. However, the present cargo-handling capacity is insufficient to meet the forecast demand. Therefore, it is necessary to provide specialized dry bulk handling facilities. At Karachi port, various kinds of dry bulk cargoes are being handled at conventional berths, such as fertilizer, rice, phosphate, scrap, etc.

Therefore, it is necessary to provide specialized dry bulk handling facilities in future and same is being planned by PQA.

12.1.4 Comparaison

COMPARISON OF PORT CHARGES (KPT VS PQA)

Description	Karachi Port Trust	Port Qasim Authority
Wharfage Charges	Coal for Rupees 44 per ton	Coal for Rupees 34 per ton per day
Storage Charges	Rupees 0.30 to 0.80 per ton per day up to Rupees 70 per ton per day after 40 days	Per ton per day first 15 days: rupees 26 Next 15 days: rupees 36 Till Clearance, rupees 63
Berth fees	US$ 0.05 per GRT (Gross Registered Tonnage)	US$ 0.08 per GRT for first 24 hours with subject to the minimum of US$ 300 and US$ 0.02 per GRT thereafter
Haulage, towage and movement of ship	Ship movement Inward: US$ 970 per tug per act Outward: rupees 50.000 per tug for first hour and rupees 20.000 per tug per hour Within breakwater movement rupees 25.000 per tug for first hour and rupees 12.0000 per tug per hour thereafter	Pilotage free US$ 0.24 per GRT for more than 50.000 GRT vessel Towing vessels i) for use of each tug: US$ 600 tug per hour ii) detention charges: US$ 300 per tug per hour iii) Charges for preparing tug when requisition is countermanded: US$ 500 per tug per day Shifting /Swinging/Movement of vessel: US0.16 per GRT
Hire of Craft and Plant within the channel	Electric Quay: rupees 3.000 per shift Heavy lift Crane: rupees 75 per ton Floating Cranes: rupees 300 per ton Mobiles Cranes i) fork lifter rupees 200 per hour ii) towing unit rupees 150 per hour iii) shunting tractor rupees 100 per hour	Hiring tug within the channel: US$ 300 per tug per hour Buoy tender: US$ 500 per tug per hour Hire of motor barge anchor hoy, water barges etc.: US$ 100 per hour Pilot boat: US$ 200 Mooring boat US$ 100 Weighment: rupees 5 per ton

	iv) trolley rupees 30 per hour v) weigh bridge rupees 6 per ton	
Fire relief and pumping charges	Karachi Port Trust and Port Qasim authority charges and categories are same as indicated in summary	Karachi Port Trust and Port Qasim Authority charges and categories are same as indicated in summary
Port Dues	US$ 0.28 per GRT	US$ 0.30 per GRT

Study reveals that most of the coal imports in Pakistan is being handled at Karachi Port Trust. PQA has dedicated Iron Ore and Coal Berth specialized for handling of raw material imports of Pakistan Steel Mills (PSM) and was commissioned in 1980 that is exclusively for PSM usage.

The existing handling capacity of KPT is 4 Million tonnes per annum of coal with storage area of 700,000 – 800,000 tons at any point of time.

KPT is planning for the development of a dedicated coal terminal at Karachi Port on BOT basis. Consultants in this regard are being currently appointed and no further details available in this regard.

At present PQA have four berths for handling of coal. These are Marginal wharves 1-4 with a total quay length of 800 meters (200x4) along with 134,000 m2 storage area is available. PQA has 6-7 million tons of design capacity for handling various commodities including coal. Currently there is minimal coal is being handled due to environmental concerns and lack of dedicated terminal.
To cope with the need of the country and power projects, a dedicated berth is being constructed for coal and clinker at Port Qasim Authority in collaboration with the private investor in the name of Pakistan International Bulk Terminal (PIBT) on a 30 year Build, Operate and Transfer (BOT) basis. PIBT is being developed as Pakistan's first state-of-the-art dirty bulk cargo handling terminal to be built at an estimated cost of US $ 185 Million.

The project is under construction and is expected to be operational by the year 2015, with the capability of handling up to 12 million tons per annum of dirty bulk cargo, which in includes coal, clinker & cement. Initially in 2015, PIBT would be capable of handling 8 million tons per annum of coal, cement and clinker. The jetty will have a depth of 15 meters and length of 460 meters and will be capable of handling two ships of up to 75,000 Dead Weight Tonnage (DWT) simultaneously.

The jetty will be connected to the backup area of 25 hectares with a 2.5 kilometers long trestle with two convener belts. Coal, Cement and Clinker storage capacity will be 900,000 tons; 540,000, tons (nine silos of 6000 tons each) and 360,000 tons respectively. PIBT will have exclusive rights for coal handling in the Port Qasim after commissioning date.

KPT & PQA will have cumulative capacity of 8 million tons per annum for coal handling after commissioning of PIBT. KPT plans for expansion are not clear, therefore we have assumed existing capacity of KPT for this purpose as existing coal handling facilities will be closed at KPT once new terminal is operational. We have prepared future forecasts for imported coal in Pakistan based on the publicly available data / information as given in Annex "PS-2" and compared with existing and future port handling capacities. The analysis shows that even if 50% of expected coal imports will be done, still Pakistani ports could have capacity to handle Lalpir / PakGen requirements subject to successful COD of PIBT project and contract negotiations now by the management.

It is also pertinent to mention that PIBT/Marine Group of Companies are planning to invest in rail linkages of the terminal with Pakistan Railways network and further investment in upcountry freight train operations. This group has already been shortlisted by GOP/Pakistan Railways for operating freight train from Karachi to Daudkhel for Coal & Cement.

We recommend that management of LalPir / Pak Gen to start discussion with management of PIBT for signing of MoU, space reservation and other modalities on priority basis. Similarly, when management of KPT float tenders for new coal bulk terminal, the same opportunity may be explored by Nishat Group. Further, management may also consider entering into discussions with PIBT to provide one stop solution for coal handling and transportation of coal (through freight trains) to LalPir / Pak Gen site.

12.1.5 Conclusion & Recommandations - PORT SELECTION FOR LALPIR/PAKGEN IPP PROJECT

Most of the coal imports in Pakistan is being currently handled at Karachi Port Trust. However, keeping in view the LalPir/PakGen massive coal import requirements, existing logistics/congestion issues at Karachi Port, future import estimates/forecasts and ports handling capacity, rail linkages/congestion issues from inner Karachi and upcoming state art of art/mechanized dirty cargo terminal at Port Bin Qasim -PIBT, use Port Bin Qasim for import of coal for the project seems to be a preferredoption.
It is recommend that management of LalPir / Pak Gen to start discussion with management of PIBT for signing of MoU, space reservation and other modalities on priority basis

Selection of seaport from rail point of view (Forwarding point):

If Karachi port is selected as port for import of coal, Kemari station/Groyne yard or Wazir Mansion station will be used as forwarding stations. In such case, turn around time will be would be 6 days resulting in an increase in the requirement of Rolling Stock and also cost of the project will be increased. Port Bin Qasim/PIBT terminal is more feasible as time required at Kemari for shunting between Groyne yard and departure yard will be saved. Moreover, transportation charges will be less if train departure from Jumma Goth due to reduction in distance. It will provide clear way for transportation of coal from PIBT/Port Bin Qasim through Marshalling Yard Pippri/Bin Qasim yard to LalPir and congestion will be avoided.

Therefore we recommend Port Bin Qasim for uplifting of coal through freight train for onward transportation to site.

12.2 RAILWAYS

12.2.1 PAKISTAN RAILWAYS

Pakistan Railways comprises of the following three functional units:

- Operations Unit
- Manufacturing & Services Unit
- Development Unit

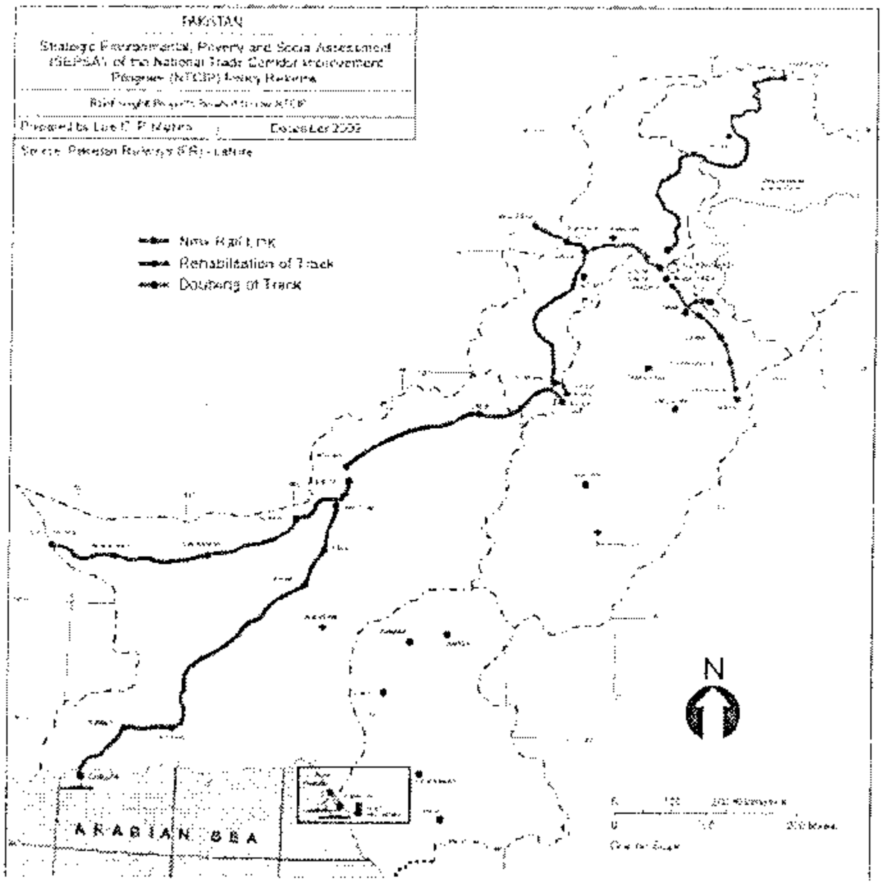
Pakistan Railways comprises of seven operating Division i.e. Peshawar, Rawalpindi, Lahore, Multan, Sukkur, Karachi & Quetta. Workshops Division at Mughalpura and Administrative Division at Headquarter. The territorial divisions and workshops are each headed by a Divisional Superintendent directly under the authority of General Manager Operations.

Railways used to be the most important mode of transportation in Pakistan some decades ago (in particular in 1955-1960 with 73% of freight insured by rail and 27% by road – (based on data Pakistan Economic Survey 2010-11, Statistical Annex, Table 13.1)

Its market share shrunk steadily as government-owned Pakistan Railways (PR) did little to improve its efficiency while a dynamic road sector emerged, integrated by a myriad of privately-owned units competing intensely in a largely unregulated environment.
At its peak between 1955 and 1960, railways handled 73 percent of freight traffic; currently it handles less than four percent of the total freight traffic.

Railway infrastructure, technology, and equipment is obsolete, which leads to significant transport delays and safety hazards. Pakistan Railways owns a very small fleet of modern train wagons that can run at high speeds; the majority of wagons are obsolete. Signalling and the telecommunications system are out-dated and create delays as well as safety hazards. Other Pakistan Railways shortcomings include: (i) running numerous unnecessary lines; (ii) cross-subsidizing passengers from freight and the non-core network from the core network; (iii) offering supply-driven services; and (iv) failure to downsize staff, streamline operations, and reduce costs and tariffs.

Proposed New Rail Links and Rehabilitation Measures;



Map drafted by World Bank consultant Luis Miglino based on primary information provided by Pakistan Railways Lahore,

12.2.2 Requirement of special purpose wagons for coal transportation

For timely provision/feeding of coal to the boiler furnace, a quick and uninterrupted mechanism for unloading of coal from wagons is needed. Manual unloading requires more effort and time to unload a train comprising of 25 wagons with a carrying capacity of 60 tonnes per wagon.

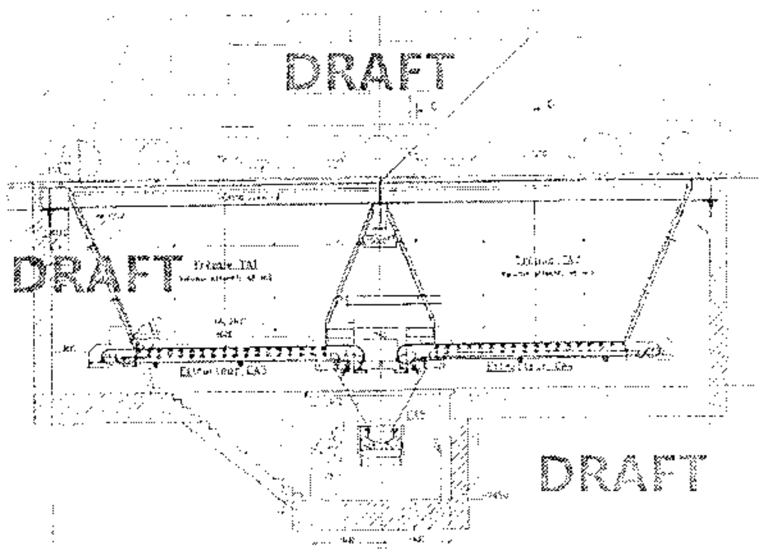
Today's automatic special purpose wagons like Hopper are not available, and Pakistan Railways can offer ZBKC high side high capacity wagons.
ZBKC wagons are manually loaded and unloaded which results in wastage of time at loading and unloading sites.

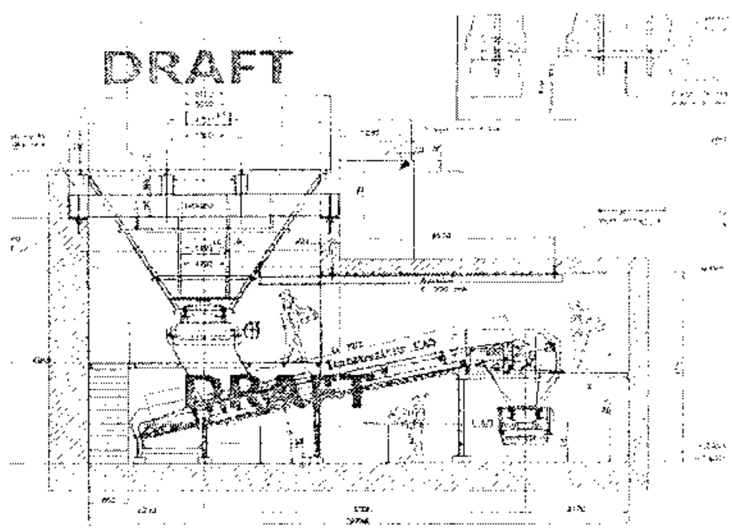
We recommend to use Hopper wagons for unloading of coal and onward stacking of coal through conveyors to the storage area.
Hopper wagons with bottom discharge arrangement are mainly used for transportation of bulk commodities like coal, iron ore etc.

The main feature of Hopper wagon is the automatic rapid discharge of coal with the help of electro-pneumatic operation of the bottom doors, facilitating quick and complete discharge.

However, it is important to note that in most parts of the world hopper wagons with side opening are manufactured and used for transportation of coal. Selection of hopper wagons with side or bottom opening depends on the design of storage area and conveyors to be used.

Layout of special purpose wagons with bottom discharge are shown below;





12.2.3 Data

Distance from Karachi Port to Lalpir/Mahmoodkot Railway station	955	Km
Distance from Port Bin Qasim to Lalpir/Mahmoodkot Railway station	915	Km
Turnaround time - Karachi port to Lalpir/Mahmoodkot	6	Days
Turnaround time – port Bin Qasim to Lalpir/Mahmoodkot	5	Days

12.2.4 Railways transport

12.2.5 Preamble

The new track railway for the supply of coal from the main line and the ways to operate will be carried out on the east dam of the plant.

12.2.6 From LalPir Railway

Storage area for coal is available inside the boundary wall of power plant. For this purpose railway siding linking LalPir and Power Plant needs to be established from LalPir Railway Station to the storage area of plant. Crossing turnout will be placed about 2.1 Km away from station building at Muzaffargarh siding and railway siding will pass from East side of the station building moving towards North, making a sharp curve and turning by 90° radius and will move straight to the plant.

Total length of track will be 5 Km including 2 loop lines of 700 meter each. The train will be moved in and out of the plant using middle line/siding with the help of shunting engine connected to the rakes from the front. In this case only two lines will be used for unloading of coal.

12.2.7 From Mahmood Kot Railway Station

Total length of track will be 5.75 Km including two loop lines of 700 meter each for unloading of coal. The train will be placed by pushing into the storage area and there will be no need for shunting.

12.2.8 Selection of railway stations at receiving end – LalPir Site

Mahmood Kot railway station seems more feasible option as compared to LalPir Station keeping in view the below mentioned facts:

- Length of new siding from Mahmood Kot to the plant is higher by 0.665 meters as compared to that of LalPir.
- Curves radius is 4 degree at Mahmood Kot and 3.7 degree at LalPir siding i.e sharper as compared to Mahmood Kot which is a problem.

- Three additional loop lines are available at Mahmood Kot whereas, no loop line is available at LalPir. In case due to problem/defects created on siding inside plant, the coming train can be placed on one of three available loop lines at Mahmood Kot. These facilities are not available at LalPir.

12.2.9 Existing possible routes for transportation of coal– from Karachi to the project site

At present there is no railway siding available either from LalPir Railway station and Mahmood Kot Railway station to power plant. Options for laying of Railways siding from LalPir & Mahmood Kot station are summarized as under::

There are two possible routes from Karachi to Mahmood Kot and LalPir Railway Stations, one through Main line and other through Branch line. Main line is double track and is recommended for usage.
Main Line of Railway is double track upto Shershah Junction near Multan.
From Sher shah Junction train will change its track towards the Branch Line through Muzaffarabad railway station to LalPir / Mahmood Kot Railway Stations. However Branch line is single track and is used to connect surrounding stations.

16 freight trains can operate as per current PR traffic schedule on our proposed route.
Most of the traffic by Pakistan Railways is transported through the section between Karachi and Lahore (1,219 km) in the main corridor (Karachi-Multan-Lahore-Rawalpindi-Peshawar) and it is expected to be so in future as well.

13 CONCLUSION

The geographical position of the power plant and climatic conditions must be taken into account in the design of the new units and in particular for the coal storage due to the strong influence of the moisture on the efficiency of the boiler.

Regarding the technical performance required to respect the electrical network demand, evolutionary environmental constraints, and the aim to limit the investments, while improving the cost of electricity, the solution proposed by CdF INGENIERIE is to retain the subcritical PC boiler.

The new boilers will be implemented at the HFO areas. This results in a low impact on the future efficiency and performance of the installation.

The boiler will be sized with the imported coal but within margins for certain eligible parameters.

IN-PRINCIPLE AGREEMENT
REGARDING
ENGINEERING, PROCURMENT AND CONSTRUCTION (EPC) CONTRACT

FOR

362 MW COAL CONVERSION OF RFO PLANT
OF LALPIR POWER LIMITED
AT MUZAFFARGARH, PAKISTAN

BETWEEN

LALPIR POWER LIMITED
("OWNER")

AND

HARBIN ELECTRIC INTERNATIONAL CO.
("CONTRACTOR")

DATED: 24th JULY 2014

THIS IN-PRINCIPLE AGREEMENT (hereinafter called this "Agreement") is made and entered into at Lahore on this 24th day of July 2014 by and between:

Lal Pir Power Limited, a company duly organized and existing under the laws of Pakistan, with offices located at 1-B, Aziz Avenue, Canal Bank, Gulberg-V, Lahore, Pakistan, (hereinafter called the "Owner"); and

Harbin Electric International Co. Ltd, a company duly organized and existing under the laws of the Peoples' Republic of China, with offices located at No 39, SanDaDongLi Road, Xiangfang District, Harbin, China (hereinafter called the "Contractor").

The Owner and the Contractor are hereinafter individually referred to as a "Party" and collectively referred to as the "Parties."

RECITALS

a) **WHEREAS,** the Owner owns and operates a 362 MW (gross) residual fuel oil (RFO) power generation facility (the "Facility" or the "Plant") at Muzaffargarh, Pakistan (the "Site") for selling power and energy generated by the Facility to the Pakistan Water and Power Development Authority ("WAPDA" or the "Power Purchaser") under a Power Purchase Agreement as amended from time to time ("PPA").

b) **AND WHEREAS,** desires to convert the Plant into a coal fired plant, and to, *inter alia*, add new plant and equipment, as more fully described in Annex I attached hereto (the "Conversion Plant"); and

c) **AND WHEREAS,** the Contractor is *inter alia* in the business of designing, engineering, equipment procurement, construction, installation, start-up, testing, commissioning and training services for coal fired plants and has submitted a proposal to the Owner for engineering, procurement and construction ("EPC") of the Conversion Plant as per the terms of this Agreement.

d) **AND WHEREAS,** this In-principle Agreement is based on the Proposal HEI submitted on 30th, June, 2014.

NOW, THEREFORE, in consideration of the mutual covenants herein contained, the Parties hereto agree as follows:

1. Scope of Work

The Contractor shall design and engineer the Conversion Plant and procure the equipment for the Conversion Plant and shall arrange a construction contractor for on-shore work, such as, erection, testing and commissioning of the Conversion Plant and achievement of commercial operations of the Conversion Plant having a gross capacity of

362 MW. The Contractor shall be responsible for all work of the on-shore construction contractor and shall guarantee the same.

2. Guaranteed Performance

The Contractor guarantees the Conversion Plant performance (with tolerances and including margins for instrument inaccuracies and all other factors) as under and the Contractor shall comply with the PPA:

i.	Net capacity of the Conversion Plant measured at:	329.42 MW
ii.	Minimum boiler efficiency guaranteed:	89%
iii.	Coal consumption	136 Ton/hr

3. Emissions

The Contractor confirms that the Conversion Plant emissions and noise level shall be within acceptable limits as per Pakistan's National Environmental Quality Standards. Guaranteed values shall be specified in the EPC Contract (defined below).

4. EPC AND CONTRACT PRICE

The parties along with the on-shore construction contractor shall enter into a detailed EPC contract to cover, *inter alia*, these terms, including on-shore contractor work under the on-shore contract (collectively, the "EPC Contract") within four months of this Agreement and the price of the EPC Contract shall be as under (the "EPC Price"):

a) Off-Shore Portion

Supply of plant and equipment (CFR (Incoterms 2010))	US$ 219,000,000.

b) On-Shore Portion

Civil works, erection, testing, Commissioning and other incidental services	US$ 29,000,000.
Total:	**US $ 248,000,000.**

5. <u>Terms of Payment for Supply of Plant and Equipment</u>

a) Off-Shore Portion

All payments will be made under a letter of credit and title to the plant and equipment will be transferred at the port of export.

b) On-Shore Portion

All payments will be made under a letter of credit and title to the plant and equipment will be transferred when payment made.

Detailed terms and conditions of payments will be given in the EPC Contract.

6. Commercial Operations

The Contractor shall achieve commercial operations date not later than 36 months from the release of the Contractor as such date may be extended with mutual written consent.

7. Performance Security

The Contractor shall submit a performance security for 15% of the EPC Price from a bank acceptable to the Owner plus 5% retention money from every approved invoice.

8. Liquidated Damages

Detailed terms and conditions on liquidated damages will be mentioned in the EPC Contract.

9. Supply of Information

The Contractor agrees to supply all information related to the Conversion Plant as reasonably requested by the Owner.

10. Validity

This Agreement shall remain valid until the EPC Contract is executed, which execution shall take place within 120 days from the date of signing of this Agreement. In case the EPC Contract is not executed as aforesaid due to any reason attributable to the Contractor, then the Owner shall be entitled to terminate this Agreement without any obligation on its part. However, the Contractor shall be liable to pay the advance if any taken by it under and pursuant to this Agreement.

11. Governing Law

This Agreement and subsequent Contracts to be signed by the Parties shall be governed by the laws of England.

12. Dispute Resolution

The Parties agree that all disputes arising between the Parties in connection with this Agreement and the contracts to be signed later shall be settled through mutual discussions in good faith within (30) days. In the event the Parties do not reach an agreement within

LAL PIR POWER LTD

Annex-I

Scope of Work: (In this scope, off-shore work will be done by the off-shore contractor and on-shore work will be done by the on-shore contractor)

LAL PIR Power Limited intends to convert its existing HFO fired 362 MW unit on imported coal. The company is interested to award the engineering, procurement and construction (EPC) contract for the replacement of oil fired boiler (1 X 1200 ton/hr) to be built at District Muzaffargarh in Pakistan, by sub critical pulverized coal fired boiler of the similar capacity (1185 ton/hr). The steam pipes and water pipes will be redesigned and revised layout for connecting the new PC boiler, the equipments for new boiler will be designed for stability, safety and high efficiency operation. The plants would be of Chinese make but international standard would be followed for complete project scope.

In addition to installation of new PC boiler, the scope of work includes:

- Installation of the associated coal unloading, storage and coal feeding system.
- The ash handling, storage and disposal systems.
- ESP & FGD system along with associated auxiliaries.
- All related civil, mechanical, electrical and HVAC works and the necessary instrumentation.
- The resolve of all interface and interconnection matters to tie in the new boilers with the existing plants, with its integration in the existing MHI turbines of same capacity, along with its integration in the existing plant control systems and the plant electrical systems.
- Existing Turbine & Generator will remain as it is and would not be replaced.

The proposed new boiler shall be of the latest and proven technology. It is designed for a minimum of 30 years of design life time, applying best engineering practices from the first perspective for operation, maintenance and has world class performance, to be environmental friendly and to maintain high reliability, availability in their configuration, equipment lay-out, control systems and so forth.

The subject of the scope of supply shall therefore include planning, design, engineering, project management, procurement of equipment and materials, manufacture, construction including labour supervision, temporary facilities and services, and construction equipment, tools and consumables, erection & installation, international and local transportation.

Any temporary works to public highway or facilities require to facilitate transport of equipment and material to site including, reinstatement fees, and compensation, etc... for any disturbances and permits for material movements, testing, quality inspections, initial start-up, tests, inspections for commissioning, Vendor or Supplier assistance and inspection acceptance, functional testing (reliability run), personnel training, documentation and any other supply or service additionally necessary to achieve realization, by way of a "turnkey"-type contractual agreement, of the aforementioned new power plants.

Technical Detail:

Following is the brief technical detail of power plant:

Description	units	Value
Net Generation	MW	329.42
Superheated steam outlet flow	t/h	1185
Superheated steam outlet temperature	°C	541
Feed water temperature	°C	283.3
Reheat steam outlet flow	t/h	978
Reheat steam inlet pressure	Kg/cm²g	40.5
Reheat steam outlet pressure	Kg/cm²g	38.3
Reheat steam outlet temperature	°C	541
Reheat steam inlet temperature	°C	337.8

Environmental Limits:

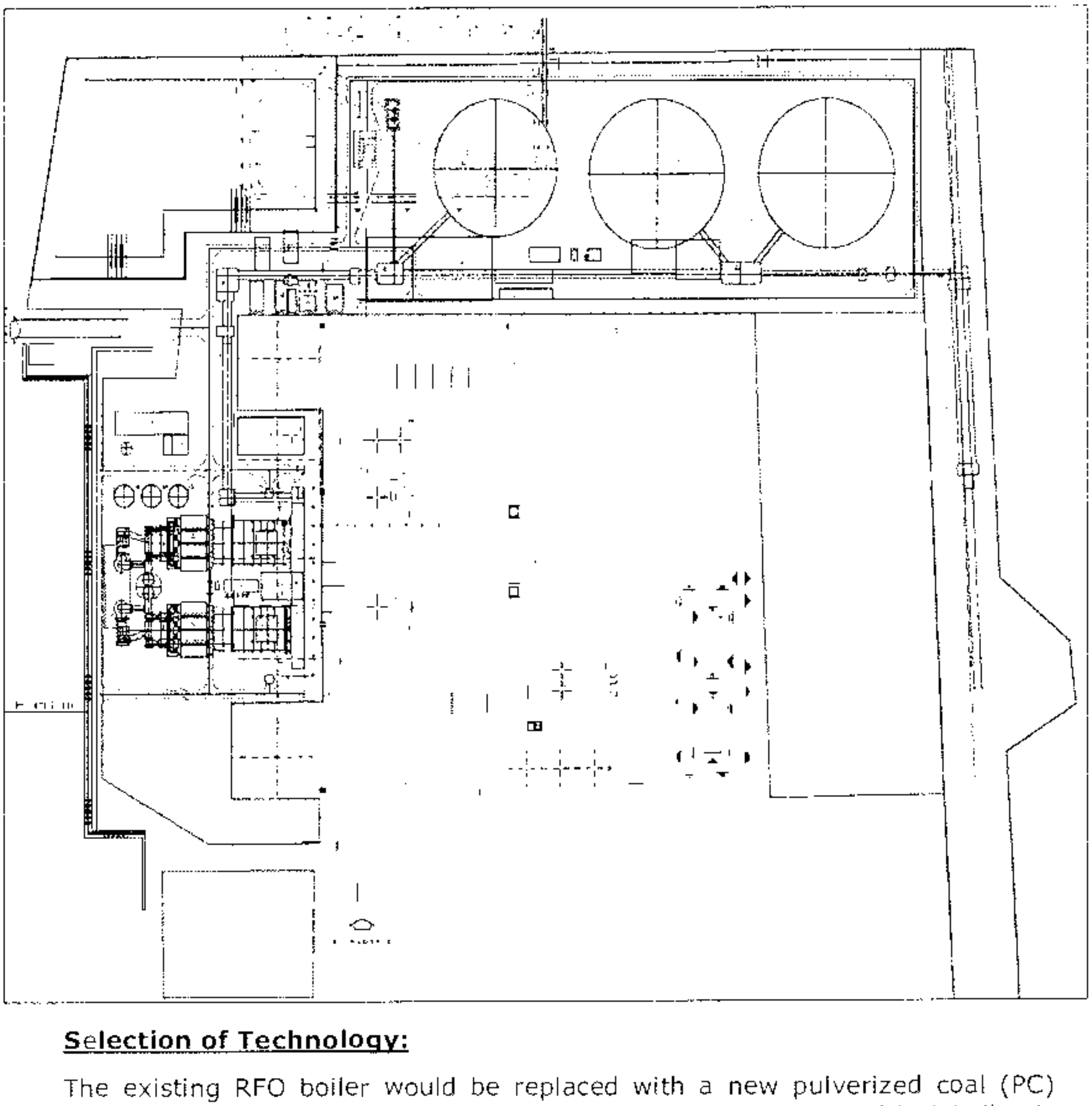
Plant would be designed in order to comply with all environmental limits (NEQs) mentioned by EPA Punjab and any other foreign banks obligations towards environmental parameters, where required.

General layout of the power plant

The new built retrofitting site contains 3 main parts the main power building area, the dusting area, the coal yard area.
New Boilers will be erected on West side of the power plant (dismantling of HFO tank 2 to 4 in particular) .Coal bunker bay, boiler, are arranged from the east to the west. The central building and air compressor room are arranged between the two boilers.
The dusting area is next to the boilers. E.S.P, I.D FANS, chimney, absorbing tower are arranged from the east to the west. Fly ash silo, desulfurization complex building, emergency slurry tank, limestone storage shed are arranged at the north direction of the chimney.
The coal yard area will be located in the north of the plant. There are coal yard, weighbridge, coal contained wastewater treatment station, coal yard rainwater settling pond, coal yard spray water pond in this area. The coal will be transported to the coal bunker bay by the coal handing conveyer.

The railway will be arranged on the eastern dam of the plant and the elevation of the dam is not clear at present. The local coal will be transported to the plant by the truck.
The workshop and ware house is arranged at the north direction of the boiler. Domestic sewage water treatment station, domestic and firefighting water pond, domestic and firefighting water pump house, water drainage pump house, rain water reclaimed treatment station are arranged at the south direction of the ash yard.
Some existing facilities need to be demolished or moved. The buildings and structures which are on the route of the coal handing conveyer will be demolished or moved. At present, the function of the buildings and structures is not clear. It could be demolished or moved whether or not will be verified by the owner.

General Layout of power plants after coal conversion would be as follows;



Selection of Technology:

The existing RFO boiler would be replaced with a new pulverized coal (PC) fired subcritical boiler having the capacity of 362 MW. Sub critical boiler is chosen to meet the requirements of existing turbine. This requirement cannot fulfill by any other type of boiler of higher technology. This sub critical boiler will be hooked up with existing turbine after replacement of its associated ancillaries.

The new boiler would be larger in size than RFO boiler for similar output. Additionally, the coal feeding system, ash removal system and addition of environmental compliance equipment increases the space requirement significantly as compared to the footprint of existing RFO fired boiler. In any case, if the new boiler is placed at the existing boiler site, the Complex would have to be shut down for almost 3 years first to remove the existing boiler and then to install a new boiler at the same location which will result a lot of additional fixed costs and extended unavailability of the Complex.

Therefore, the new boiler will be built at a new location, while the existing Complex keeps operating, and the Complex will be shut down for only 6 months, to make the switch. The existing RFO fired boiler will be left in place and simply blinded. The feed water lines going into the existing boiler and the steam lines coming out of the boiler and going into the turbine will be cut off and redirected and while they will be a little longer, thereby resulting a slightly higher heat loses, this will result in the least cost solution.

Description of New Equipment:

The fuel conversion project named as Lal Pir Power Limited 362 MW (gross) coal fired thermal power plant involves the engineering, design, transportation, delivery at site, erection, installation, testing and commissioning of the following components:

(i) Pulverized coal boiler

(ii) Coal unloading, handling, storage and coal forwarding system;

(iii) Coal preparation section including hammer-mills, sifters, and feeding conveyors;

(iv) Ash handling, storage and disposal system including on clay line landfill

(v) All related civil works;

(vi) Interfacing and interconnection to tie-in the boiler with the plant; and

(vii) New distributed control system to integrate the new boiler and existing turbine to the control room.

Fuel System:

The boiler unit is designed to fire coal. HSD oil will be used for ignition and combustion supporting. Imported coal will be used as a primary fuel. However, the new boiler shall be based on 100% imported coal.

Boiler Ignition and Combustion-support System:

The startup or ignition fuel will be HSD oil. The original HSD oil tank shall be taken into use. However, the existing RFO system will not be used for the new coal-fired boiler. HSD oil will be used for boiler start-up and combustion stability.

Primary Air System:

This system main supplies hot air and cold air to mill and boiler burner. The system there are two 60% capacity Centrifugal P.A. fan, its import is equipped with the silencer. In order to cause a two air fans export wind pressure to be balanced, hot primary air duct and cold one primary air duct all have header.

Secondary Air System:

This system supplies needed combustion air for boiler. It has two 60% capacity the moving blade adjustable axial-flow fans with inlet silencer. In order to cause two fan outlet air pressure balanced and nimbleness operation, contacting air duct will be equipped after the fan outlet dampers. In order to cause hot second air pressure balanced, contacting air duct will be equipped after preheater outlet dampers.

Gas System:

This system extracts gas from the chamber, through the rear part heating surface, the air preheater, the electrostatic precipitator the chimney to the atmosphere. Plant will set up FGD system. There are inlet and outlet of FGD at the flue gas total duct in front of chimney. After the electrostatic precipitator, it is equipped with two 60% capacity stationary vane adjustable axial flow I.D. fan.

Chimney:

The flue gas of boiler comes in a common chimney, the chimney height is 210 meters, double steel channels with diameter is 5.5 meters.

Primary Fuel:

Imported coal will be used as a primary fuel.

Raw Coal Unloading System:

In wagon unloading a coal shed will be provided, and two paddle feeders will be provided to discharge coal from wagon unloading to belt conveyor. Coal will be delivered to transfer tower by belt conveyor. In transfer tower, coal will be transferred to international circular coal storage yard by belt conveyor and circular stacker or transferred to local circular coal storage yard by belt conveyor and circular stacker or directly to boiler house by supplying conveyors.

The capacity of paddle feeders will be 400~800t/h, and vibrating feeders will be 600t/h. Conveyors in unloading system will be with belt width of 1200mm, speed of 2.8m/s and capacity of 1200t/h.

Coal Storage system:

The storage capacity of circular coal yards will be about 150, 000Tons, diameter of 120 m. One local circular coal yard will be provided. The storage capacity of circular coal yard will be about 50,000 Tons, diameter of 110 m. One circular stacker/reclaimer will be equipped on circular coal yards for stacking and reclaiming. Its stacking capacity will be 1200t/h and reclaiming capacity will be 1000t/h. In circular coal yard, two uncoalers will be provided, one operation, one standby. The capacity of uncoalers will be 500~1000t/h. Two bulldozers will be supplied for auxiliary work. A bulldozer garage will be provided with water recycling.

Dust suppression:

The mixing water pumps installed under the fly ash silos, it will supply water for fly ash silos and bottom ash silos discharging wet fly ash. The water supplied must satisfy the discharging of both the fly ash silos at the same time.

Ash handling Systems:

According to the concrete conditions of the project, the fly ash shall be conveyed to fly ash silo by pneumatic conveying method. The bottom ash shall be transported by submerged scraper conveyor(SSC) to bottom ash silo to store. Both fly ash and bottom ash shall be transported to ash yard or ash users by trucks.

Bottom Ash Handling System:

One submerged scraper conveyor (SSC) will be equipped for boiler. The bottom ash shall be cooled by water and conveyed to the bottom ash silo by submerged scraper conveyor (SSC), and then bottom ash drops into bottom ash silo for storage and concentration. Finally the bottom ash will be transported from bottom ash silo to ash yard by special trucks.

Fly Ash Handling System:

Boiler has 1 set of positive dense phase pneumatic conveyance system. The system will be equipped under the electrostatic precipitators. The fly ash from the Electrostatic Precipitator hoppers shall drop into the ash transportation equipment and then be transported to the fly ash silos through pipes. The capacity of each set positive dense phase pneumatic conveyance system should meet the fly ash quantity can meet 150% fly ash quantity which is produced on BMCR condition burning design coal.

Railway and Road:

Today, the power plant is not connected to railway. The existing railway lines and the two closest railways station (MahmootKot and Lal Pir Railway Stations) are located at about 1 to 2 km. The Owner will ensure the construction of a connection line from existing line up to power plant fence. The railway will be arranged in the east of the power plant.
Access to the site is a paved road off the D.G.Khan-Kot Addu Highway. For the roads in the plant area, some of the roads need to be demolished. If the existing roads need to be renewed, the width of the new road will follow the original width. If new roads need to be built, the width of main road will be 7m and the sub-road will be 4m. Most of the turning radius is 9.0m. Its surface will be cement concrete pavement.

Other Auxiliary Equipment:

- Coal Pulverizing System
- Coal Feeder
- Pulverizer
- Gas & Air System
- Boiler feed water pumps
- FGD System

Coal Handling System:

The design scope of coal handling system will be from the unloading facilities to the coal bunkers in boiler house. This includes the following:

- Unloading System
- Coal Storage
- Coal Yard Equipment
- Supplying System
- Bending & Crushing system

Ash Handling System:

Ash Handling System includes following:

- Bottom Ash Handling System
- Fly Ash Handling System
- Mixing Water System
- Air Compressor System

Limestone powder convey system:

LimeStock Blocks will be used as desulfurization absorbent. The system includes:

- Lime Stone Unloading System
- Lime Stone Gate Room
- Gypsum Dewatering System

Commercial Consideration:

Following are the performance guarantees for the project:

Functional Guarantee	Performance Guarantee requirements	
Minimum Net electrical output per unit (1)	329.42	MW
Minimum Boiler efficiency at following parameters (a) steam water parameters at nominal value, (b) 4 hours stability, (c) bottom and fly ash extraction stabilized, and (d) blow-down at zero	89	%
Minimum duration of stable load without oil support at design coal firing	40	%

Coal Consumption	136	t/hr
Capacity factor	85	%

Commercial Proposal:

EPC Price for 362 MW LalPir Power Limited: US$ 248 MM
Work not included in scope: Demolition work, Railway and Road
Project time line: 36 months