中國機械設備工程股份有限公司
China Machinery Engineering Corporation
House No. 8, Street No. 41, F-7/1, Islamabad.Phone: +92 51 2652553; Fax: +92 51 2652550

Ref: PDKPP-3
Date: 26 January 2015

Registrar
National Electric Power Regulatory Authority (NEPRA)
NEPRA Tower, Ataturk Avenue (East)
Sector G-5/1, Islamabad

Subject: **Application for a Generation License for CMEC**

I, Su Guanglei, being the duly authorized representative of China Machinery Engineering Corporation("CMEC"), by virtue of Power of Attorney dated 15 December 2014, hereby apply to the National Electric Power Regulatory Authority for the grant of a Generation License to the CMEC pursuant to section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997. We are in the process of setting up a local Special Purpose Vehicle (SPV) company in Pakistan which will be held by CMEC or CMEC's subsidiary. Once the SPV in Pakistan is established, the generation license will be novated/assigned to this SPV.

I certify that the documents-in-support attached with this application are prepared and submitted in conformity with the provisions of the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, and undertake to abide by the terms and provisions of the above said regulations. I further undertake and confirm that the information provided in the attached documents-in-support is true and correct to the best of my knowledge and belief.

A crossed cheque No. 00400494 for Rs. 683,120.00 (Rupees Six Hundred Eighty-three Thousand One Hundred Twenty Only), being the nonrefundable license application fee calculated in accordance with Schedule – II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, is also attached herewith.

Su Guanglei
Authorized Representative
China Machinery Engineering Corporation

中国機械設備工程股份有限公司
China Machinery Engineering Corporation

Ref. No. 20141215 Date: 15 December 2014

POWER OF ATTORNEY

KNOW ALL MEN BY THIS PRESENTS, that I, the undersigned, Mr. Zhang Chun, President of China Machinery Engineering Corporation (hereinafter referred to as CMEC), organized under the law of the People's Republic of China, and situated at No. 178, Guanganmenwai Street, Beijing, P. R. China, hereby appoint Mr. Su Guanglei, as my true and lawful representative to

(i) Register CMEC Branch Office / Liaison Office in Pakistan and perform all matters related to this registration

(ii) Execute Neelum Jhelum Hydropower Project and follow up business developments in Pakistan.

Mr. Su Guanglei is authorized to take the responsibilities of Principal Officer of CMEC in Pakistan.

I hereby confirm, ratify, and accept the responsibilities for and caused by the above conduct by Mr. Su Guanglei.

This Power of Attorney shall come into force from date of this letter and remain valid till further notice.

Authorized by:

Zhang Chun
President of China Machinery Engineering Corporation

To be authorized:

Su Guanglei

中国国际贸易促进委员会

China Council for the Promotion of International Trade
China Chamber of International Commerce

证 明 书
CERTIFICATE

号码 No. 141100B0/60779

兹证明： 在所附文件上的中国机械设备工程股份有限公司的印章属实。

THIS IS TO CERTIFY THAT: the seal of CHINA MACHINERY ENGINEERING CORPORATION on the annexed DOCUMENT is genuine.

China Council for the Promotion of International Trade

授权签字

Authorized Signature : *SunJia*

日期：2014 年12月25日

(Date: DEC. 25, 2014)

认字第140238276-004号

兹证明前面文书上中国国际贸易促进委员会商事证明专用章和授权签字人（孙嘉）的签字属实。

中华人民共和国外交部

一等秘书

一辆年二月三十日

3993923

IJAZ AHMED
COUNSELLOR (CA)
Embassy of Pakistan

Seal & Signature of the Ministry of Foreign Affairs are authentic NOT the Contents of this documents

The original version of the Articles of Association of the Company is in Chinese, and the English version of the Articles of Association is the translation from the Chinese original. Should there be any discrepancy between the Chinese and English versions of the Articles of Association, the Chinese version shall prevail.

The Articles of Association of the Company were adopted at the second extraordinary shareholders' general meeting on June 25, 2011. Subsequently, further amendments to the Articles of Association were also considered and approved, which shall be announced upon the listing of H Shares of the Company in Hong Kong and shall become effective from the date of trading of H Shares of the Company in Hong Kong on December 21, 2012. At the 2012 annual general meeting of the Company held on June 17, 2013 and the 2013 annual general meeting of the Company held on June 26, 2014, the shareholders considered and approved further amendments to the Articles of Association.

中国机械设备工程股份有限公司
China Machinery Engineering Corporation*

(a joint stock limited company incorporated in the People's Republic of China with limited liability)

(Stock Code: 1829)

Articles of Association

2014

* *For identification purposes only*

Contents

Articles of Association of China Machinery Engineering Corporation

Chapter 1 General Provisions

Article 1 China Machinery Engineering Corporation (the "Company") is a joint stock limited company established in accordance with the Company Law of the People's Republic of China (the "PRC") (the "Company Law"), the Securities Law of the People's Republic of China (the "Securities Law"), the Special Regulations of the State Council of the PRC (the "State Council") on the Overseas Offering and Listing of Shares by Joint Stock Limited Companies (the "Special Regulations"), the Mandatory Provisions for the Articles of Association of the Companies to be Listed Overseas (the "Mandatory Provisions") and other applicable laws and administrative rules of the PRC.

Upon approval by State-owned Assets Supervision and Administration Commission of the State Council ("SASAC"), the Company was established by way of restructuring and transformation of China National Machinery & Equipment Import & Export Corporation. On January 18, 2011, the Company was registered with the State Administration for Industry and Commerce of the PRC ("SAIC") with its Corporate Business License (Registered Number: 100000000000715).

The promoters of the Company are China National Machinery Industry Corporation (the "SINOMACH Group") and China United Engineering Corporation (the "China United").

Article 2 The Company's registered Chinese name: 中國机械設備工程股份有限公司 ("中國机械工程")

The Company's English name: China Machinery Engineering Corporation ("CMEC")

Article 3 Domicile of the Company: No.178, Guanganmenwai Street, Xicheng District, Beijing

Postal code: 100055
Tel: 86-10-63451188
Fax: 86-10-63261865

Article 4 The legal representative of the Company shall be the chairman of the Board of Directors (the "Board").

Article 5 The Company is a perpetually existing joint stock company with limited liability.

Article 6 The Articles of Association of China Machinery Engineering Corporation (the "Articles") was adopted by the special resolution of shareholders' general meeting. Upon approval by the relevant departments of the PRC, the Articles shall become effective on the date when the overseas listed foreign shares are listed on The Stock Exchange of Hong Kong Limited (the "SEHK") and replace the Articles of Association which has been registered with SAIC.

From the date on which the Articles become effect, the Articles shall become a legally binding document which regulates the organization and conduct of the Company, the rights and obligations between the Company and the shareholders, and among the shareholders.

Without prejudice to the provisions of the Articles, the shareholder shall have the right to take legal action against the Company and other shareholders; the shareholders shall have the right to take legal action against the directors, supervisors, general manager and other senior management officers (including vice general managers, chief financial officer, chief engineer, secretary of the Board, assistants to the general manager, general counsel and other senior management officers employed by the Board when necessary (same as below)). The Company shall have the right to take legal action against the shareholders, directors, supervisors, general manager and other senior management officers.

For the purpose of the legal action referred to in the preceding paragraph, the term legal proceeding shall include the initiation of proceedings in a court or the application of arbitration to an arbitration organization.

Article 7 The Articles are binding on the Company and its shareholders, directors, supervisors, general manager and other senior management officers of the Company; all of whom are entitled, according to the Articles, to make claims in respect of rights concerning the matters of the Company.

Article 8 Unless otherwise provided by laws, the Company may invest in other enterprises provided, however, that it shall not become an investor that shall bear several and joint liabilities for the debts of the enterprises which it invests in.

Chapter 2 Objectives and Scope of Business

Article 9 The business objectives of the Company are to: make its presence in the international market, adhere to the prospects of operating practically and innovatively, continue to enhancing its competitiveness, and become a learning-oriented top notch multinational enterprise of PRC, adopting internationally advanced technologies and a people-centric approach. In addition, the Company aims to serve for the modernization of the PRC and facilitate the level of modernization of human society through its operation and business activities.

Article 10 The business scope of the Company shall be the scope which has been approved by the relevant company registration authority of the PRC.

The business scope of the Company includes:

Principal businesses: licensed business items: dispatching work force to overseas. General business items: import and export business; contracting and undertaking overseas projects, bidding agency business services; organization of foreign economic and technological exhibitions in the PRC; foreign trade consulting and advertising services, organizing trade show services; technical consulting and services in relation to the above businesses; sales of mechanical equipments, electrical equipments, electronic equipments, instruments and apparatus, packaging materials and construction materials.

The business scope referred to in the preceding paragraph shall be the scope as audited by the relevant company registration authority.

The Company may, based on any change in domestic and international markets, business development and its own capability, adjust its scope of business and complete the relevant formalities required by the industry and commerce administration registration regime accordingly.

Chapter 3 Share, Registered Capital and Share Transfer

Article 11 The Company shall have ordinary shares at all times. The Company may create other classes of shares if necessary upon approval by the examining and approving department authorized by the State Council.

Article 12 All shares issued by the Company shall take the form of stocks with par value of indicated in RMB, which shall be RMB1 for each share.

Renminbi referred to in the preceding paragraph shall mean the lawful currency of the PRC.

Article 13 Upon approval by the securities authority of the State Council, the Company may issue shares to investors inside the PRC and to investors outside the PRC.

For the purposes of the preceding paragraph, the term "investors outside the PRC" shall refer to investors from foreign countries or from Hong Kong, Macao or Taiwan that subscribe for shares issued by the Company, and the term "investors inside the PRC" shall refer to investors inside the PRC, excluding the above-mentioned regions, that subscribe for shares issued by the Company.

Article 14 The shares issued by the Company to investors inside the PRC and to be subscribed for in Renminbi shall be referred to as "domestic shares". Shares issued by the Company to investors outside the PRC and to be subscribed in a foreign currency shall be referred to as "foreign shares". Foreign shares listed overseas shall be referred to as "overseas listed foreign shares". Both holders of domestic shares and overseas listed foreign shares are all holders of ordinary shares and shall enjoy the equal rights and bear the same obligations.

Foreign currencies referred to in the preceding paragraph represent the legal currencies of other countries or regions other than Renminbi that are recognized by competent authorities of the State Administration of Foreign Exchange for the payment of share subscription to the Company.

Article 15 Overseas listed foreign shares issued by the Company and are listed in Hong Kong shall be referred to as H Shares. H Shares are shares which have been admitted for listing on the SEHK, the par value of which are denominated in Renminbi and which are subscribed for and traded in Hong Kong dollars.

Article 16 Upon approval by the examining and approving authorities authorized by the State Council, the total number of ordinary shares that the Company may issue is 3,300,000,000 which have been fully subscribed and held by the promoters of the Company.

Article 17 Upon approval by the securities regulatory authority of the State Council, the Company may issue 825,700,000 overseas listed foreign shares (included 107,700,000 over-allotment shares) upon its establishment. Pursuant to the Provisional Procedures for the Reduction of State Owned Shareholdings and the Raising of Social Security Funds and the relevant regulations of the State Council, the state-owned shareholders of the Company would transfer 82,570,000 state-owned shares held by it to the National Council for Social Security Fund (the "NSSF") when issuing overseas listed foreign shares.

Upon the completion of the above issuance (with the over-allotment option exercised in full), the shareholding structure of the Company shall be as follows: 3,185,255,700 shares held by the SINOMACH Group, representing approximately 77.21% of the total shares issued by the Company; 32,174,300 shares held by the China United, representing approximately 0.78% of the total shares issued by the Company; 82,570,000 shares held by the NSSF, representing approximately 2.0% of the total shares issued by the Company; and 825,700,000 shares held by the holders of overseas listed foreign shares, representing approximately 20.01% of the total shares issued by the Company.

Article 18 After the plan for issuing overseas listed foreign shares and domestic shares has been approved by the securities regulatory authorities of the State Council, the Board may arrange for implementation of such plan by means of separate issue.

The Company's plan for separate issues of overseas listed foreign shares and domestic shares in accordance with the preceding paragraph may be implemented separately within 15 months of being approved by the securities regulatory authorities of the State Council.

Article 19 Where the total number of shares stated in the proposal for the issuance of shares includes overseas listed foreign shares and domestic shares, such shares should be fully subscribed for at their respective offerings. If the shares cannot be fully subscribed for in one tranche due to special circumstances, the shares may, subject to the approval of the securities authority of the State Council, be issued in several stages.

Article 20 The registered capital of the Company, at the time of its establishment, was RMB3,300,000,000. Upon the listing of the Company, the registered capital shall be RMB4,125,700,000.

Article 21 Except as otherwise provided for in the laws and administrative regulations, shares of the Company shall be freely transferrable and clear of any lien.

Chapter 4 Increase, Reduction and Repurchase of Shares

Article 22 The Company may, based on its operating and development needs and in accordance with laws, regulations and the Articles, increase its registered capital in the following ways, subject to special resolution adopted by the shareholders' general meeting:

(1) by offering new shares to non-specially-designated investors for subscription;

(2) by placing new shares to its existing shareholders;

(3) by allotting bonus shares to existing shareholders;

(4) by issuing new shares to specially-designated investors;

(5) by capitalizing its capital reserve;

(6) by any other methods which is permitted by competent supervisory authorities or laws and administrative regulations.

The Company's increase in capital by issuing new shares shall be handled in accordance with the procedures provided for in the relevant PRC laws and administrative regulations and after having been approved in accordance with the Articles.

Article 23 The Company may sell the shares of any untraceable shareholder and retain the proceeds, if:

(1) during a period of 12 years dividends in respect of the shares in question have been distributed at least three times and no dividend has been claimed; and

(2) upon expiry of the 12 years, the Company, with the approval by securities regulatory authorities of the State Council, gives notice of its intention to sell the shares by way of an advertisement published in the newspapers, and notifies the authority, the place of the overseas stock exchange where the Company's shares are listed and the relevant securities regulatory authorities of such intention.

Article 24 Pursuant to the Articles, the Company may reduce its registered capital. Such reduction shall be made in accordance with the procedures set out in the Company Law, other relevant requirements and the Articles.

Article 25 The Company must prepare a balance sheet and a property inventory when it reduces its registered capital.

The Company shall give notices to the creditors within 10 days after the date on which the resolution is passed regarding the reduction of its registered capital and shall publish an announcement in the newspaper within 30 days. The creditors are entitled to require the Company to repay the debts or provide corresponding guarantees within 30 days after the receipt of such notices or within 45 days if no such notice is received.

The Company's registered capital after reduction shall not be less than the statutory minimum amount.

Article 26 The Company may, in accordance with the provisions set out in the laws, administrative regulations, Listing Rules of the SEHK, departmental rules and the Articles and subject to the approval of the relevant governing authorities of the PRC, buy back its own shares under the following circumstances:

(1) cancel its shares for the purpose of reducing its registered capital;

(2) merger with another company holding shares in the Company;

(3) grant shares as incentive compensation to the staff of the Company;

(4) request the Company to buy back shares held by shareholders disputing resolutions passed during shareholders' general meetings in relation to the merger or division of the Company;

(5) other circumstances permitted by the laws and administrative regulations.

Article 27 The Company may repurchase its shares in one of the following ways with approval from relevant governing authorities of the State:

(1) making a pro rata offer of repurchase to all its shareholders;

(2) repurchasing shares through public dealing on a stock exchange;

(3) repurchasing shares by an off-market agreement.

Article 28 The Company must obtain prior approval of the shareholders' general meeting, in the manner stipulated in the Articles, before it can repurchase shares by reason of those mentioned in Subparagraphs (1) to (3) of Article 26 of the Articles, or repurchase shares by means of an off-market agreement. The Company may, by obtaining prior approval of the shareholders' general meeting in the same manner, rescind or vary, or relinquish its rights under, an agreement which has been so entered into.

The contracts to buy back shares as referred to in the preceding paragraph includes, but not limited to, an agreement to become obliged to buy back or to acquire of the right to buy back.

The Company shall not assign a contract for the buy-back of its own shares or any of its rights thereunder.

Article 29 The price of shares which the Company has the right to buy back for redemption shall limit to a maximum price if the purchases are not made through the market or by tender. If purchases are by tender, tender shall be available to all shareholders alike. The Company shall not assign any contract in relation to repurchase its shares or any right as provided therein.

Article 30 Shares lawfully repurchased by the Company under Subparagraph (1) of Article 26 herein shall be cancelled within ten days from the date of acquisition; for those shares repurchased under Subparagraphs (2) and (4) of Article 26 shall be transferred or cancelled within six months; and the shares acquired by the Company in accordance with Subparagraph (3) of Article 26 herein shall not exceed 5% of the Company's shares in issue, and the shares acquired shall be transferred to the staff within one year.

If the Company lawfully cancels the shares repurchased, it shall register the changed registered capital with the original company registration authority and make an announcement accordingly.

The aggregate par value of the cancelled shares due to repurchase shall be deducted from the Company's registered capital.

Article 31 Unless the Company is in the course of liquidation, it shall comply with the following provisions when repurchasing its issued shares:

(1) where the Company repurchases shares of the Company at par value price, payment shall be deducted from the book balance of distributable profits of the Company and the proceeds from the new share issue for the purpose of repurchasing the existing shares;

(2) where the Company repurchases shares of the Company at a price higher than the par value, the portion equivalent to the par value shall be deducted from the book balance of the distributable profits of the Company and the proceeds from the new share issue for the purpose of repurchasing the existing shares; the portion beyond the par value shall be handled as follows:

i. if the shares repurchased are issued at par value, the payment shall be deducted from the book balance of the distributable profits of the Company;

ii. if the shares repurchased were issued at a price higher than the par value, payment shall be deducted from the book balance of the distributable profits of the Company and the proceeds from the new share issue for the purpose of repurchasing the existing shares; however, the amount deducted from the proceeds from the new share issue shall neither exceed the aggregate premium from the issue of the existing shares repurchased nor shall it exceed the amount (including the premiums from the new share issue) in the premium account (or capital reserve account) at the repurchase;

(3) Payments for the following purposes shall be made out of the Company's distributable profits:

i. acquisition of the right to repurchase shares of the Company;

ii. modification of any contract to repurchase shares of the Company;

iii. release of any of the Company's obligation under any contract for the repurchase of its shares;

(4) after the total par value of the cancelled shares is deducted from the Company's registered capital in accordance with the relevant requirements, the amount deducted from the distributable profits for the repurchase of the shares at par value shall be included in the Company's premium account (or capital reserve account).

Chapter 5 Financial Assistance for Purchase of Shares of the Company

Article 32 The Company or its subsidiaries shall not, by any means at any time, provide any kind of financial aid to a person who acquires or proposes to acquire shares of the Company. "The person" referred to in the preceding sentence shall include a person who directly or indirectly incurs any obligation due to the acquisition of shares.

The Company or its subsidiaries shall not, by any means at any time, provide any form of financial aid to the aforesaid obligor for the purpose of reducing or discharging the obligations assumed by that person.

This article does not apply to the circumstances mentioned in Article 34 of this Chapter.

Article 33 "The financial aid" referred to in this Chapter shall include, but not limited to, the following meanings:

(1) gift;

(2) guarantee (including the assumption of liability by the guarantor or the provision of assets by the guarantor to secure the performance of obligations by the obligor), compensation (other than compensation in respect of the Company's own default), relief or waiver of rights;

(3) provision of loan or conclusion of agreement under which the obligations of the Company are to be fulfilled before the obligations of another party, or a change in parties to, or the assignment of rights under, such loan or agreement; and

(4) any other form of financial aid given by the Company when the Company is insolvent or has no net assets or when its net assets would thereby be reduced to a material extent.

"Assuming an obligation" referred to in this Chapter shall include the assumption of obligations by way of contract or by way of arrangement (irrespective of whether such contract or arrangement is enforceable or not, and irrespective of whether such obligations are to be borne by the obligor solely or jointly with any other persons), or by any other means, which results in a change in the obligor's financial position.

Article 34 The following activities shall not be deemed to be activities prohibited by Article 32 of this Chapter:

(1) the provision of financial aid by the Company where the financial aid is given in good faith in the interest of the Company, and the principal purpose of which is not for the acquisition of shares of the Company, or the giving of the financial aid is an incidental part of a master plan of the Company;

(2) the lawful distribution of the Company's assets as dividends;

(3) the distribution of dividends in the form of shares;

(4) a reduction of registered capital, a repurchase of shares or a reorganization of the share capital structure effected in accordance with the Articles;

(5) the provision of loans by the Company for ordinary business activities within its scope of business (provided that the net assets of the Company are not thereby reduced or that, to the extent that the assets are thereby reduced, the financial aid is provided out of distributable profits); and

(6) the provision of money by the Company for contributions to staff and workers' share schemes (provided that the net assets of the Company are not thereby reduced or that, to the extent that the assets are thereby reduced, the financial assistance is provided out of distributable profits of the Company).

Chapter 6 Share Certificates and Register of Members

Article 35 Share certificates of the Company shall be in registered form.

In addition to those provided in the Company Law, a share certificate of the Company shall also contain any other items required to be specified by the stock exchange(s) on which the shares of the Company are listed.

During the listing of the Company's H Shares on the SEHK, the Company shall at any time ensure that the following statements are included in all title documents (including H Share certificates) relating to its securities listed on the SEHK:

(1) the purchaser of the shares and the Company and each of the shareholders, and the Company and each of the shareholders agree to observe and comply with the requirements of the Company Law and other relevant laws, administrative regulations and the Articles.

(2) the purchaser of the shares agrees with each of the Company's shareholders, directors, supervisors, general manager and other senior management officers of the Company, and the Company, acting on behalf of itself and each of directors, supervisors, general manager and other senior management officers of the Company, agrees with each of the shareholders that, they will refer to arbitration for settlement of all disputes and claims arising from the Articles, or disputes and claims of rights in relation to the Company's affairs arising from any rights or obligations under the Company Law or other relevant PRC laws and administrative regulations in accordance with the provisions of the Articles, and that any referral to arbitration shall be deemed as an authorization to an arbitral tribunal to hold a public hearing and announce its arbitration award to the public. Such award shall be final and binding on all the parties.

(3) the purchaser of the shares agrees with the Company and each of the shareholders of the Company that the shares of the Company may be freely transferable by the holder.

(4) the purchaser of the shares authorizes the Company to enter into a contract on his behalf with each of the directors, general manager and other senior management officers, pursuant to which the directors, general manager and other senior management officers undertake to observe and fulfill their responsibilities under the Articles to the shareholders.

The Company shall instruct and procure its share registrar not to register the subscription, purchase or transfer of any of its shares in the name of any individual holder unless and until such holder delivers to such share registrar a completed and signed form in respect of such shares bearing the aforesaid statements.

Article 36 The shares of the Company may be transferred, donated, inherited and pledged in accordance with the relevant laws, administrative regulations and the Articles. The assignment and transfer must be registered with the share registrar entrusted by the Company.

Article 37 The share certificates shall be signed by the chairman of the Board. Where the stock exchange on which the Company's shares are listed requires the share certificates to be signed by other senior management officers, the share certificates shall also be signed by such senior management officers. The share certificates shall take effect after being affixed, or affixed by way of printing, with the seal of the Company. The share certificates shall only be affixed or printed with the Company's seal under the authorization of the Board. The signatures of the chairman of the Board of the Company or other relevant senior management officers on the share certificates may also be in printed form.

Article 38 The Company shall maintain a register of members and register the following particulars:

(1) the name, address (domicile), occupation or nature of each shareholder;

(2) the class and number of shares held by each shareholder;

(3) the amount paid or payable by each shareholder for the respective shares held;

(4) the serial numbers of shares held by each shareholder;

(5) the date when each shareholder is registered as a shareholder;

(6) the date when each shareholder ceases to be a shareholder.

The register of members shall be the sufficient evidence of the shareholders' shareholding in the Company, unless there is evidence to the contrary.

Subject to the Articles and other applicable requirements and upon transfer of the Company's shares, the transferees of the shares will become the holders of such shares with their names being entered in the register of members.

Any event or transfer of overseas listed foreign shares shall be recorded on the register of members for holders of overseas listed foreign shares maintained at the place of listing in accordance with Article 39 herein.

Where two or more than two persons are registered as joint holders of any share, they should be deemed as joint owners of such share and subject to the following restrictions:

(1) the Company shall not register more than 4 persons as joint holders of any share;

(2) all joint holders of any share shall jointly and severally assume obligation for all amounts payable for relevant shares;

(3) if one of the joint holders dies, only the surviving joint holders shall be deemed by the Company to be such persons as having the ownership of the relevant shares. The Board shall have the right, for the purpose of making amendments to the register of members, to demand a death certificate where it deems appropriate to do so; and

(4) in case of joint holders of any shares, only the joint holder whose name appears first in the register of members is entitled to receive the share certificates of relevant shares and notices from the Company, and to attend or exercise all voting rights of such shares at a shareholders' general meeting of the Company. Any notice delivered to that person shall be deemed as having been delivered to all joint holders of the relevant shares.

Article 39 The Company may, pursuant to the mutual understanding and agreement made between the securities regulatory authorities under the State Council and overseas securities regulatory authorities, maintain its original register of members of overseas listed foreign shares overseas, and mandate overseas agent(s) to manage such register. The original copy of register of members of overseas listed foreign shares listed in Hong Kong shall be maintained in Hong Kong.

The Company shall maintain a copy of the register of members of overseas listed foreign shares in the premises of the Company. Overseas agency so mandated shall at any time ensure the consistency of the original version and the copy of the register of members of overseas listed foreign shares at all times.

If there is any inconsistency between the original copy and the copy of the register of members of overseas listed foreign shares, the original copy shall prevail.

Article 40 The Company shall maintain a complete register of members.

The register of members shall include the following parts:

(1) the register of members maintained in the domicile of the Company other than those described in Subparagraphs (2) and (3) of this Article;

(2) the register of members of overseas listed foreign shares maintained in the place of stock exchange where the shares are listed;

(3) the register of members maintained in other places as the Board may consider necessary for the purpose of the listing of the Company's shares.

Article 41 Different parts of the register of members shall not overlap. No transfer of any shares registered in any part of the register shall, during the continuance of that registration, be registered in any other part of the register.

Alterations or amendments on each part of the register of members shall proceed in accordance with the laws of the place where that part of the register of members is maintained.

Article 42 All transfer of overseas listed foreign shares shall be carried out in general or common format, or any other written transfer instrument format acceptable to the Board; a written transfer document may be signed under hand without a seal. In the event that the transferor or transferee of the shares of the Company is a recognized clearing house ("Recognized Clearing House") as defined under the law of Hong Kong or its agent, a written transfer instrument may be signed in a machine-printed form.

All paid-up overseas listed foreign shares which are listed in Hong Kong are freely transferable pursuant to the Articles. However, the Board may refuse to recognize any instrument of transfer without giving any reason, unless:

(1) a fee (for each instrument of transfer) of HK$2.5 or any higher fee as determined by the Board has been paid to the Company to register the instrument of transfer of shares and other documents relating to or affecting the ownership of such shares, provided that it shall not exceed such highest fees as prescribed from time to time by the SEHK in the Listing Rules;

(2) the instrument of transfer involves only the overseas listed foreign shares listed in Hong Kong;

(3) the stamp duty payable on the instrument of transfer has been paid;

(4) the relevant share certificates and any other evidence reasonably required by the Board showing that the transferor has the right to transfer such shares have been provided;

(5) if the shares are to be transferred to joint holders, the number of joint holders shall not exceed 4;

(6) the Company does not have any lien over the relevant shares.

If the Company refuses to register any transfer of shares, it shall provide the transferor and the transferee of the shares with a notification of refusal in relation to registration of shares within two months from the application for registration.

Shares held by promoters of the Company shall not be transferred within one year after the Company's establishment.

Subject to the approval of the securities regulatory authorities of the State Council, holders of domestic shares of the Company may transfer the shares held by them to foreign investors and have the shares listed and traded overseas. The shares transferred shall comply with the regulatory procedures, provisions and requirements of the overseas securities market when listed and traded in an overseas stock exchange. The listing and trading of the transferred shares in an overseas stock exchange are not subject to the holding of a class meeting for voting.

The directors, supervisors, general manager and other senior management officers of the Company shall report to the Company the number of shares held by them in the Company and the subsequent changes in their shareholdings. The number of shares which such persons may transfer every year during their terms of office shall not exceed 25% of the total number of the Company's shares in his or her possession. Such personnel shall not transfer the Company's shares in their possession within half year after they have terminated their employment with the Company.

Article 43 Within 30 days prior to the convening of a shareholders' general meeting or within five days prior to date for the determination of the basis of dividend distribution by the Company, no change shall be made in the register of members as a result of a transfer of shares.

Article 44 Whenever the Company convenes a shareholders' general meeting, distributes dividends, liquidates and engages in other acts requiring the confirmation of shareholding, a day shall be determined by the Board as the record date for the registration of shareholdings, upon the expiry of which, those members who appear in the register of members shall be the shareholders of the Company.

Any person who has an objection to the register of members and requests to have his name entered in or removed from the register of members may apply to a court of competent jurisdiction for rectification of the register.

Article 45 Any member registered in the register of members or any person requesting for the registration of his name in the register of members may apply to the Company to reissue new share certificate for his respective shares (i.e. "Relevant Shares") if his share certificate (i.e. "original share certificate") is lost.

Application by a holder of domestic shares who has lost his share certificate and applies for replacement shall be dealt with in accordance with the Article 144 of the Company Law.

Application by a holder of overseas listed foreign shares who has lost his share certificate and applies for replacement shall be dealt with in accordance with the laws of the place where the original copy of the register of members of overseas listed foreign shares is maintained and the rules of the stock exchange or other relevant regulations.

In case that a holder of H Shares has lost his share certificate and applies for replacement, the issuance of a replacement share certificate shall comply with the following requirements:

(1) Applicant shall submit his application in the standard form prescribed by the Company with the notarial certificate or statutory declaration attached. The notarial certificate or statutory declaration documents shall include the ground for application, circumstances and evidence of the loss of the share certificate, as well as a declaration that no other person may request for the registration as the holder of the Relevant Shares.

(2) Before the Company makes the decision on the reissuance of new share certificate, no declaration of the request for the registration as members of such shares by any person other than the applicants has been received.

(3) In case the Company decides to reissue new share certificate to the applicant, an announcement of such reissuance shall be published on the newspapers designated by the Board at least every 30 days within a period of 90 days. The newspapers designated by the Board shall be at least one Chinese and English newspaper recognized by the SEHK.

(4) Before the Company publishes the announcement of the reissuance of a share certificate, a copy of the announcement intended to be published shall be submitted to the SEHK. Upon the receipt of response from such stock exchange that confirms that such announcement has been exhibited in the premises of the SEHK, the announcement may be published. Such announcement shall be exhibited in the premises of the SEHK for a period of 90 days.

If the application for the replacement of share certificate is made without the consent of the registered holder of the Relevant Shares, the Company shall deliver a copy of the announcement intended to be published to such shareholder by post.

(5) Upon the expiration of 90 days period of the announcement and exhibition referred to in Subparagraphs (3) and (4) of this Article, if no objection on the replacement of the share certificate has been received by the Company, a new share certificate may be issued pursuant to the applicant's application.

(6) When the Company issue new share certificate pursuant to this Article, the original share certificate shall be cancelled immediately, and such cancellation and replacement shall be registered in the register of members.

(7) All costs for the cancellation of the original share certificate and the issuance of new share certificate incurred shall be borne by the applicant. Until the applicant provides any reasonable guarantee the Company shall be entitled to reject to take any action.

Article 46 After the issuance of a new share certificate by the Company pursuant to the Articles, the name of the bona fide purchaser acquiring the aforesaid new share certificate or of the person (a bona fide purchaser) subsequently registered as the owner of such shares shall not be removed from the register of members.

Article 47 The Company has no obligation to compensate for those who suffer loss from cancellation of original stock certificates or issuance of new stock certificates unless they can prove that the Company has fraudulent conduct.

Chapter 7 Rights and Obligations of Shareholders

Article 48 A shareholder of the Company is a person who lawfully holds shares in the Company and whose name is entered in the register of members.

A shareholder shall enjoy rights and assume obligations according to the class and numbers of shares held by such shareholder. Shareholders who hold shares of the same class shall have the same rights obligations.

Class shareholders shall enjoy equal rights in any dividends or other forms of distribution.

A shareholder of legal person shall appoint its legal representative or a proxy authorized by the legal representative to exercise its rights on its behalf.

The Company shall not exercise any of its rights to freeze or otherwise impair any of the rights attaching to any shares of the Company by reason only that persons who are interested directly or indirectly therein have failed to disclose their interests to the Company.

Article 49 The ordinary shareholders of the Company shall enjoy the following rights:

(1) the right to dividends and other types of interest distributed in proportion to the number of shares held;

(2) the right to request, convene, chair, attend and vote in person or appoint a proxy to attend and vote on his behalf at shareholders' general meetings in proportion to the number of shares held in accordance with laws;

(3) the right of supervisory management over the Company's business operations, and the right to present proposals or to raise enquiries;

(4) the right to transfer, bestow or pledge shares in accordance with laws, administrative regulations and the Articles;

(5) the right to obtain relevant information in accordance with the provisions of the Articles, including:

i. the right to obtain a copy of the Articles, subject to payment of the costs of such copy;

ii. the right to inspect and copy, subject to payment of a reasonable fee, the following:

(i) all parts of the register of members;

(ii) personal particulars of each of the Company's directors, supervisors, general manager and other senior management officers, including:

(a) present and former name and alias;

(b) principal address (place of residence);

(c) nationality;

(d) full-time position and all other part-time positions and duties;

(e) identification documents and the numbers thereof.

(iii) the state of the issued share capital of the Company;

(iv) the report showing the aggregate par value, quantity, maximum and minimum prices paid in respect of each class of shares repurchased by the Company since the end of the previous accounting year and the total expenses incurred by the Company for this purpose;

(v) minutes of shareholders' general meetings, resolutions of board meetings and resolutions of meetings of Supervisory Board;

(vi) corporate bond counterfoils;

(vii) financial reports.

(6) in the event of the termination or liquidation of the Company, the right to participate in the distribution of remaining assets of the Company in accordance with the number of shares held;

(7) the right to request the Company to purchase the shares of the shareholder who raises objection to the resolution on merger or division made at the shareholders' general meeting;

(8) shareholders individually or jointly holding 3% or more of the Company's shares can make a provisional motion in writing to the Board 10 days before the date of shareholders' general meeting;

(9) other rights conferred by laws, administrative regulations, departmental rules or the Articles.

Article 50 Holders of the ordinary shares of the Company shall have the following obligations:

(1) to abide by the laws, administrative regulations and the Articles;

(2) to contribute to the share capital according to the number of shares subscribed by them and the method of capital contribution;

(3) to assume liability of the Company based on the shares held by them;

(4) not to withdraw their fund contribution after approval and registration by the Company, except as provided in laws and regulations;

(5) other obligations imposed by laws, administrative regulations and the Articles.

Unless otherwise specified, shareholders are not liable to make any further contribution to the share capital other than as agreed by the subscriber of the relevant shares on subscription.

Article 51 In addition to obligations imposed by laws, administrative regulations or required by the listing rules of the stock exchange where the Company's shares are listed, a controlling shareholder shall not exercise his voting rights in respect of the following matters in a manner prejudicial to the interests the shareholders generally or partially:

(1) to relieve a director or supervisor of his duty to act honestly in the best interests of the Company;

(2) to approve the expropriation by a director or supervisor for his own benefit or for the benefit of another person, in any manner, of the Company's assets, including without limitation any opportunity beneficial to the Company;

(3) to approve the expropriation by a director or supervisor for his own benefit or for the benefit of another person of the individual rights of other shareholders, including without limitation the rights to distributions and voting rights save as any restructuring submitted to shareholders for approval in accordance with the Articles.

Article 52 For the purpose of the Articles, a "controlling shareholder" means a shareholder who satisfies any one of the following conditions:

(1) any person acting on his own or in concert with other parties has the power to elect not less than half of the directors;

(2) any person acting on his own or in concert with other parties has the power to exercise or control the exercise of 30% or more of the voting rights of the Company;

(3) any person acting on his own or in concert with other parties holds 30% or more of the outstanding shares of the Company;

(4) any person acting on his own or in concert with other parties has actual control over the Company in any other manner.

The term of "acting in concert" referred to in this Article represents an act that any of two or more persons obtains the voting right in the Company by way of their agreement thereon (whether in oral or in written form), so as to realize or reinforce their purpose of controlling the Company.

Chapter 8 Shareholders' General Meetings

Article 53 The shareholders' general meeting is the organ of authority of the Company and shall exercise its functions and powers in accordance with laws.

Article 54 The shareholders' general meeting shall exercise the following functions and powers:

(1) to decide the operating policies and investment plans of the Company;

(2) to elect and replace directors and to decide on matters related to the remuneration of directors;

(3) to elect and replace supervisors who are not representative of the employees of the Company and to decide on matters related to the remuneration of supervisors;

(4) to consider and approve the reports of the Board;

(5) to consider and approve the reports of the Supervisory Board;

(6) to consider and approve the annual financial budget and final accounts of the Company;

(7) to consider and approve the Company's profit distribution plan and loss recovery plan;

(8) to resolve on the increase or decrease in the registered capital of the Company;

(9) to resolve on the issue of debentures, any class of shares, any share warrants or other similar securities by the Company;

(10) to resolve on matters related to a merger, separation, dissolution, liquidation of the Company or an alteration of the form of the Company;

(11) to amend the Articles;

(12) to consider the motions raised by shareholders representing 3% or more of issued shares with voting rights;

(13) to decide on the engagement, re-appointment or dismissal of accounting firms employed by the Company;

(14) to resolve on the guarantees specified in Article 55 herein;

(15) to consider the purchase or disposal of any material asset which exceeds 30% of the Company's latest audited total assets within one year;

(16) to consider the share incentive scheme;

(17) to resolve on any other matters to be resolved thereby as required by relevant laws, administrative regulations and the Articles;

(18) to consider other matters as required by the listing rules of the stock exchange of the place where the Company's shares are listed.

The shareholders' general meeting may authorize or delegate the Board to transact the matters authorized or delegated by it.

Article 55 The following external acts of guarantee of the Company shall be considered and approved by the shareholders' general meetings:

(1) any guarantee provided after the total amount of external guarantees by the Company and its controlled subsidiaries (including the sum of the total amount of the Company's external guarantees comprising the guarantees provided by the Company for its controlled subsidiaries, plus the total amount of external guarantees provided by the controlled subsidiaries of the Company) amounts to or exceeds 50% of the latest audited net assets;

(2) any guarantee provided after the total amount of external guarantees by the Company and its controlled subsidiaries (including the sum of the total amount of the Company's external guarantees comprising the guarantees provided by the Company for its controlled subsidiaries, plus the total amount of external guarantees provided by the controlled subsidiaries of the Company) amounts to or exceeds 30% of the latest audited total assets;

(3) any guarantee provided for a guaranteed party whose gearing ratio exceeds 70%;

(4) any single guarantee for an amount equal to or more than 10% of the Company's audited net assets for the latest period;

(5) any guarantee provided to the Company's shareholders and its de facto controllers as well as connected parties of the shareholders and its de facto controllers;

(6) other external guarantees that must be considered by shareholders' general meeting of the Company according to the requirements in PRC laws, administrative rules and relevant regulations.

Article 56 The Company shall not, without prior approval of the shareholders' general meeting, enter into any contract with any person other than a director, supervisor, general manager and other senior management officers whereby the management and administration of the whole or a substantial part of the business of the Company is to be handed over to such person.

Article 57 Shareholders' general meetings are divided into annual shareholders' general meetings and extraordinary shareholders' general meetings. The Board shall convene an annual shareholders' general meeting once a year and within six months from the close of the preceding accounting year.

Extraordinary general meetings shall be convened as and when necessary. The Board shall convene an extraordinary general meeting within 2 months from the date of occurrence of any of the following events:

(1) when the number of directors is less than the number stipulated in the Company Law or two-thirds of the number specified in the Articles;

(2) when the outstanding loss of the Company reaches one-third of the Company's total paid-in share capital;

(3) where shareholders who individually or jointly hold 10% or more of the Company's shares make a request to convene an extraordinary general meeting in writing;

(4) when deemed necessary by the Board or when requested by the Supervisory Board;

(5) when proposed by two or more of independent directors;

(6) any other circumstances as stipulated by laws, administrative regulations, departmental rules, the listing rules of the stock exchange of the place where the Company's shares are listed or the Articles.

In any of the circumstances referred to in subparagraphs (3) and (4) above, the matter for consideration proposed by the party requesting the holding of the extraordinary general meeting shall be included in the agenda of such meeting.

Article 58 A shareholder's request to convene an extraordinary general meeting or class meeting should be in accordance with the following procedures:

(1) shareholders individually or jointly holding 10% or more of the shares carrying voting rights at the meeting sought to be held may sign one or more written requests of identical form and substance requesting the Board to convene an extraordinary general meeting or a class meeting and stating the topic of the meeting. The Board shall convene an extraordinary general meeting or a class meeting as soon as possible after having received the aforesaid written request. The shareholding referred to above shall be calculated as of the day on which the written request is made.

(2) if the Board fails to issue a notice of such meeting within 30 days after having received the aforesaid written notice, the shareholders who made such request shall be entitled to convene the meeting within four months after the Board received the request. The procedures for convening such meeting shall, to the extent possible, be identical to the procedures according to which general meetings are to be convened by the Board.

Article 59 When the Company convenes an annual general meeting, shareholders holding 3% or more of the total voting shares of the Company shall be entitled to propose new resolutions to the Company in writing which should be submitted to the convener 10 days prior to the convening of the general meeting. The convener of the general meeting shall issue a supplemental notice of general meeting to other shareholders within 2 days of the receipt of such proposal and incorporate such newly proposed matters falling within the scope of duties of the general meeting into the agenda of such meeting. The new agenda shall be tabled to the general meeting for consideration.

Article 60 When the Company convenes a shareholders' general meeting, written notices of the meeting shall be given 45 days (including the meeting date) before the date of the meeting to notify all of the registered shareholders of the matters to be considered and the date and the place of the meeting. A shareholder who intends to attend the meeting shall deliver his written reply concerning the attendance of the meeting to the Company 20 days before the date of the meeting.

The notice of the shareholders' general meeting shall be delivered by any means as permitted by the stock exchange of the place where the Company's shares are listed (including without limitation delivery by post, email, fax, public announcement and announcement on the websites of the Company and/or the stock exchange of the place where the Company's shares are listed) to the shareholders (whether or not such shareholders have voting rights at the shareholders' general meeting). In the case of delivery by post, the address of the recipient shall be the address specified in the register of members. For the holders of domestic shares, notice of the meeting may be issued by way of public announcement.

The public announcement referred to in the preceding paragraph shall be published in one or more newspapers designated by the securities governing authority of the State Council 45 to 50 days prior to the date of the meeting. Upon the publication of the announcement, all holders of domestic shares shall be deemed to have received notice of the relevant shareholders' general meeting. The Chinese and English versions of such public announcement shall be published in a Chinese newspaper and an English newspaper recognized by the SEHK on the same date.

Article 61 The Company shall, based on the written replies received 20 days before the date of the shareholders' general meeting from the shareholders, calculate the number of voting shares represented by the shareholders who intend to attend the meeting. If the number of voting shares represented by such shareholders amounts to one half or more of the Company's total voting shares, the Company may hold the shareholders' general meeting. Otherwise, the Company shall within 5 days notify the shareholders again by public announcement of the matters to be considered, the date and the place for the meeting. The Company then may hold the meeting after the publication of such public announcement.

An extraordinary general meeting shall not decide on matters not stated in the notice of meeting.

Article 62 Notice of a shareholders' general meeting shall:

(1) be in writing;

(2) specify the time, place and date of the meeting;

(3) set out the matters and proposals to be considered at the meeting;

(4) provide such information and explanations as are necessary for the shareholders to exercise an informed decision on the proposals before them, the principle of which includes without limitation where a proposal is made to amalgamate the Company with another, to repurchase shares, to reorganize the share capital, or to restructure the Company in any other way, specify the conditions and contracts of the proposed transaction in detail (if any) and a proper and thorough explanation of the cause and consequence of such proposal;

(5) disclose the nature and extent of the material conflict of interest, between any, of any director, supervisor, general manager and other senior management officer in the matters proposed; and the effect of the proposed matters on them in their capacity as shareholders in so far as it is different from the effect on other shareholders of the same class;

(6) contain the full text of any special resolution proposed to be passed at the meeting;

(7) contain conspicuously a statement that a shareholder entitled to attend and vote is entitled to appoint one or more proxies to attend and vote on behalf of him and that proxy need not be a shareholder;

(8) specify the time and place for lodging proxy forms for the relevant meeting;

(9) set the registration date of shareholding for shareholders who are eligible for attending the shareholders' general meeting;

(10) state the name and telephone number of the main contact person of the meeting.

Article 63 Where, due to accidental omission, a notice of meeting is not given to a person who is entitled to receive such notice or where such person has not received the notice, the meeting or any resolution adopted at the meeting shall not be invalidated as a result.

Article 64 Any shareholder entitled to attend and vote at a shareholders' general meeting of the Company shall be entitled to appoint one or more other persons (whether a shareholder or not) as his proxy to attend and vote on his behalf, and a proxy so appointed shall:

(1) have the same right as the shareholders to speak at the meeting;

(2) have authority to demand or join in demanding a poll;

(3) have the right to vote by hand or on a poll, but when more than one proxy has been appointed, the proxies only have the right to vote on a poll.

Article 65 The instrument appointing a proxy must be made in writing and signed by the appointer or his agent so authorized in writing. As for an appointer who is a legal person, the instrument shall additionally be sealed by the stamp of the legal person or signed by its director or attorney duly authorized.

Article 66 The proxy letter shall be deposited at the residence of our Company or at such a place as specified in the notice convening the meeting not less than 24 hours before the time of the meeting at which the proxy proposes to vote or the time appointed for the voting. If the proxy form is signed by a person authorized by the appointer, the power of the authorization document shall be notarized and placed together with the proxy form authorizing the proxy to vote at the registered office of the Company or other place designated in the notice of meeting.

Where the appointer is a legal person, its legal representative or other persons authorized by the resolutions of the Board or other decision-making organ may attend the shareholders' general meeting of the Company as a representative of the appointer.

Where such shareholder is a Recognized Clearing House (or its nominees), it may authorize one or more persons as it thinks fit to act as its representative(s) at any shareholders' general meeting or any class meeting provided that, if more than one person is so authorized, the power of attorney shall specify the number and class of shares in respect of which each such person is so authorized. The person(s) so authorized will be entitled to exercise the same power on behalf of the Recognized Clearing House (or its nominees) as if such person were an individual shareholder of the Company.

Article 67 Any form issued to a shareholder by the Board for appointing a proxy of shareholder shall allow the shareholder to freely instruct the proxy to cast vote in favor of or against each resolution dealing with the businesses to be transacted at the meeting. Such a form shall contain a statement that the proxy may vote as he thinks fit in the absence of shareholder's instruction.

Save as provided above, the aforesaid proxy form shall also contain the following: the number of shares represented by and name of the proxy; whether voting power is granted to the proxy; whether the proxy is entitled to vote for any temporary resolution proposed at any shareholders' general meeting; instruction of how to vote if voting power is granted; and date of appointing a proxy and the effective period for such appointment. Where a shareholder appoints more than one proxy, he shall specify the number of shares represented by each proxy in the proxy form.

Where the shareholders' general meeting is attended by a proxy, the proxy shall produce proof of identification and the dated power of attorney signed by the appointor or its legal representative. Where a corporate shareholder appoints its legal representative to attend the meeting, the legal representative shall produce proof of identification and the copy of the notarized certified resolutions of the Board appointing the said legal representative or any other certified copy permitted by the Company.

Article 68 A vote given in accordance with the terms of an instrument of proxy shall be valid notwithstanding the previous death or loss of capacity of the appointer, revocation of the proxy or of the authority under which the proxy was executed, or the transfer of the relevant shares, provided that no notice in writing of such matters has been given to the Company before the commencement of the relevant meeting.

Article 69 A shareholders' general meeting shall be convened and presided over by the chairman of the Board. If the chairman of the Board cannot attend the meeting for any reason, the vice chairman of the Board shall convene and preside over the meeting. If both the chairman and the vice chairman of the Board cannot attend the meeting, the Board shall designate a director of the Company to convene and preside over the meeting. If no chairman of the meeting has been so designated, shareholders present shall choose one person to be chairman of the meeting. If for any reason the shareholders fail to elect a chairman, the shareholder (including his proxy) attending the meeting and holding the largest number of shares vested with voting rights shall be the chairman of the meeting.

Article 70 The resolutions of shareholders' general meetings shall be classified as ordinary resolutions and special resolutions.

To adopt an ordinary resolution, votes representing more than one-half of the voting rights held by the shareholders (including proxies) present at the meeting must be passed.

To adopt a special resolution, votes representing two-thirds or more of the voting rights held by the shareholders (including proxies) present at the meeting must be passed.

A shareholder (including his proxy) attending the meeting shall vote in favour of or against each resolution relating to every matter which has been put to vote at the relevant meeting. If a shareholder or his proxy casts an abstention vote or abstains from voting, any vote cast by such shareholder or his proxy shall not be counted in the voting results of the Company.

Article 71 Shareholders (including their proxies) exercise voting rights according to the voting shares they hold when voting at the shareholders' general meeting, and each share shall have one voting right. However, shares held by the Company shall not carry voting rights, and shall not be included in the total number of voting shares present at the shareholders' general meeting.

Where any shareholder is, under the applicable laws and regulations and listing rules of the stock exchange of the place where the Company's shares are listed, required to abstain from voting on any particular resolution or restricted to voting only for or only against any particular resolution at any general meeting, any votes cast by such shareholders (or their proxies) in contravention of such requirement or restriction shall not be counted.

Article 72 Unless otherwise specified by laws, administrative regulations, relevant regulatory authorities or the listing rules of stock exchange where the Company's shares are listed, a resolution of the shareholders' general meeting may be decided by a show of hands unless a poll is demanded (before or after voting by show of hands):

(1) by the chairman of the meeting;

(2) by at least two shareholders entitled to vote in person or proxies with voting rights;

(3) by one or more shareholders (including their proxies) individually or jointly holding 10% or more of total voting shares present at the meeting.

A declaration by the chairman that a resolution has been passed by a show of hands and an entry to that effect in the meeting minutes shall be conclusive evidence of the fact that such resolution has been adopted at the meeting, without the evidence of the number or proportion of affirmative or negative votes cast.

The Company shall, only under the circumstances required by the laws, administrative regulations, relevant regulatory authorities or listing rules of stock exchange where the Company's shares are listed, disclose the number of votes in relation to a poll.

The demand for a poll may be withdrawn by the proposer for such a poll.

Article 73 A poll demanded on the election of the chairman or adjournment of the meeting shall be taken immediately. A poll demanded on any other resolution shall be taken at such time as the chairman of the meeting decides and the meeting may proceed to discuss any other matters. The results of the poll shall be deemed as a resolution adopted at the meeting at which the poll is demanded.

Article 74 On a poll taken at a meeting, a shareholder (including his proxy) who is entitled to have two or more votes need not cast his votes all for or all against a resolution.

Article 75 In the event of a tie, whether on a show of hands or on a poll, the chairman of the meeting shall have a casting vote.

Article 76 The following matters shall be resolved by an ordinary resolution at a shareholders' general meeting:

(1) work reports of the Board and the Supervisory Board;

(2) plans formulated by the Board for the distribution of profits and for making up losses;

(3) appointment or removal of members of the Board and the Supervisory Board (except for the staff representative supervisor), and their remuneration and manner of payment thereof;

(4) the Company's annual financial budgets and final accounts, balance sheets, income statements and other financial statements;

(5) matters other than those required by the laws, administrative regulations or the Articles to be adopted by special resolutions.

Article 77 The following matters shall be resolved by a special resolution at a shareholders' general meeting:

(1) the increase or decrease in the Company's share capital, and issue of shares of any class, share warrants and other similar securities;

(2) the issue of debentures of the Company;

(3) the separation, merger, dissolution and liquidation of the Company;

(4) any change in the form of the Company;

(5) any purchase or sale of substantial assets or guarantees made by the Company in a year at an amount in excess of 30% of the audited total assets of the Company for its latest accounting period;

(6) amendment to the Articles;

(7) the share incentive scheme to be considered and implemented;

(8) matters regulated by the laws, administrative regulations or the Articles, and those decided by the shareholders' general meeting, by way of an ordinary resolution, to be of a nature which may have a material impact on the Company and should be adopted by a special resolution;

(9) other matters required by the listing rules of stock exchange where the Company's shares are listed to be adopted by special resolution.

All directors, supervisors, general manager and other senior management officers shall attend the shareholders' general meeting as non-voting participants if so requested. The attending directors, supervisors, general manager and other senior management officers shall make replies or explanation in respect of inquiries by the shareholders at the shareholders' general meeting, except for on matters in relation to business secrets of the Company which cannot be made public.

Article 78 The chairman of the meeting shall determine whether a resolution at a shareholders' general meeting is passed based on the voting result. His decision, which is final and conclusive, shall be announced at the meeting and recorded in the minutes of the meeting.

Article 79 At a shareholders' general meeting, the approach and procedure for nomination of directors and supervisors are as follows:

(1) shareholders severally or jointly holding 3% or more of the total outstanding voting shares of the Company may, by way of a written proposal, put forward to the shareholders' general meeting candidates for directors and supervisors (not being the staff representative supervisor). However, the number of candidates proposed shall comply with the provisions of the Articles, and shall not exceed the number to be elected. The aforesaid proposal put forward by shareholders to the Company should be delivered to the Company at least 14 days before the convening of the shareholders' general meeting.

(2) within the number of members as specified by the Articles and based on the number of proposed candidates for election, the Board and the Supervisory Board may propose a list of recommended candidates for directors and supervisors, which shall be submitted to the Board and Supervisory Board for approval. After the list of candidates for directors and supervisors is determined based on the examination by the Board and Supervisory Board and the adoption of a resolution, it should be proposed in writing at a general meeting.

(3) the written notices of the intention to nominate a candidate for election as a director or a supervisor, the acceptance of nomination by such potential candidate, and the relevant written materials of the nominated candidate, shall be given to the Company no less than 7 days prior to the date of convening the shareholders' general meeting. The Board and Supervisory Board shall provide shareholders with the resume and basic information of the candidates for directors and supervisors.

(4) the period given by the Company to nominators and nominees for providing the aforesaid notice and documents shall be no less than 7 days (such period shall commence from the day following the date of serving the notice of convening the shareholders' general meeting).

(5) in the shareholders' general meeting, each candidate for a director and a supervisor must be voted on separately.

(6) in the case of ad hoc addition or replacement of any director or supervisor, the Board and Supervisory Board shall put forward a proposal to the general meeting for such election or replacement.

Article 80 If the chairman of the meeting has any doubt as to the result of a resolution put to vote, he may double count the votes. If the chairman does not recount the votes and the attending shareholders or their proxies challenge the voting result announced by the chairman, the shareholders or their proxies can request for a recount immediately after the announcement of the result, and the chairman shall recount the votes immediately.

Article 81 If the counting of votes is held at the shareholders' general meeting, the counting result shall be recorded in the minutes of the meeting. The minutes of the meeting and the attendance records signed by the attending shareholders and proxies shall be kept at the Company's domicile.

Article 82 When the shareholders' general meeting is considering any guarantee to be provided by the Company to its shareholder or de facto controller, the shareholder and its de facto controller mentioned above shall abstain from voting. The proposal shall be passed by more than a half (not including a half) of votes of other shareholders present at the meeting with the relevant voting rights.

Article 83 Copies of the minutes of the meeting shall, during business hours of the Company, be open for inspection by any shareholder without charge. If a shareholder demands from the Company a copy of such minutes, the Company shall send a copy to him within 7 days of verifying his identity and the receipt of reasonable charges.

Chapter 9 Special Procedures for Voting by Class Shareholders

Article 84 Shareholders holding different classes of shares are class shareholders.

Class shareholders are entitled to the rights and shall take the obligations pursuant to laws, administrative regulations and the Articles.

If the Company proposes to modify or terminate the rights of a class of shareholders, it may do so only after such modification or termination has been approved by a special resolution of the shareholders' general meeting and a separate shareholders' general meeting convened by the affected shareholders of that class under the Articles 86 to 90.

Article 85 In the following conditions, rights of a class of shareholders shall be deemed to have been modified or terminated:

(1) An increase or decrease in the number of shares of such class or an increase or decrease in the number of shares of a class having voting rights, distribution rights or other privileges equal or superior to those of the shares of such class;

(2) Conversion of all or part of the shares of such class into shares of another class, conversion of all or part of the shares of another class into shares of such class or the grant of the right to such conversion;

(3) Cancellation or reduction of rights to accrued dividends or cumulative dividends attached to shares of such class;

(4) Reduction or cancellation of a dividend preference or property liquidation preference during liquidation of the Company, attached to shares of such class;

(5) An addition, cancellation or reduction of share conversion rights, options, voting rights, transfer rights, pre-emptive rights or rights to acquire securities of the Company attached to shares of such class;

(6) Cancellation or reduction of rights to receive amounts payable by the Company in a particular currency attached to shares of such class;

(7) Creation of a new class of shares with voting rights, distribution rights or other privileges equal or superior to those of the shares of such class;

(8) Imposition of restrictions or addition of such restrictions on the transfer or ownership of shares of such class;

(9) Issuance of rights to subscribe for shares of such class or other class, or rights to convert shares;

(10) An addition of the rights and privileges of shares of other classes;

(11) A restructuring scheme of the Company resulting in shareholders of different classes bearing liability not in proportion to the restructuring; and

(12) An amendment or cancellation of the provisions of the Articles.

Article 86 Shareholders of the affected class, having the right to vote at shareholders' general meetings or otherwise, shall nevertheless have the right to vote at class meetings in respect of matters concerning subparagraphs (2) to (8), (11) and (12) of Article 85, but shareholders with interests shall not be entitled to vote at meetings of shareholders of class shares.

A "shareholder with interests" refers to:

(1) A controlling shareholder as defined in Article 52 of the Articles, in the case of a repurchase of shares by pro rata offers to all shareholders or by public dealing on a stock exchange pursuant to Article 27 of the Articles;

(2) A shareholder in connection with a proposed contract, in the case of a repurchase of shares by an off-market contract is achieved pursuant to Article 27 of the Articles;

(3) A shareholder who bears less than a proportionate amount of obligations imposed on or whose interests diverge from those of the shareholders of that class, in the case of in a restructuring scheme of the Company.

Article 87 Resolutions of meetings of class shareholders shall be adopted by votes representing two thirds or more of the voting rights of shares of that class which are entitled to vote and whose shareholders present at the meeting pursuant to Article 86.

Article 88 Written notice of a class meeting shall be sent 45 days prior to the date of the meeting to inform all of the shareholders in the share register of the class of the matters to be considered, the date and venue of the class meeting. A shareholder proposing to attend the class meeting shall deliver his written reply with respect to the attendance at the meeting to the Company 20 days prior to the date of the class meeting. The quorum for a class meeting (other than an adjourned meeting) to consider a variation of the rights of that class of shares shall be the holders of at least one-third of the issued shares of that class.

If the number of shares carrying voting rights at the meeting represented by the shareholders proposing to attend the class meeting reaches one half or more of the shares entitled to voting rights at the class meeting, the Company may hold the class meeting; if not, the Company shall within 5 days once again notify the shareholders of the class by means of public announcement, of matters to be considered, the date and the venue of the class meeting. The Company may then hold the class meeting after notification by announcement.

Article 89 In the event that a class meeting is convened by serving a notice of meeting, such notice only needs to be served on shareholders entitled to vote thereat.

Meetings of any class of shareholders shall be conducted in a manner as similar as possible to that of a shareholders' general meeting. The provisions of the Articles relating to the manner of conducting any shareholders' general meeting shall apply to any meeting of a class of shareholders.

Article 90 Apart from holders of other classes of shares, the holders of the domestic shares and overseas listed foreign shares are deemed as shareholders of different classes.

The special procedures for voting by a class of shareholders shall not apply to the following circumstances:

(1) where upon the approval by a special resolution of shareholders in a general meeting, either separately or concurrently once every 12 months, the Company issues domestic shares and overseas listed foreign shares not more than 20% of each that has been issued;

(2) where the Company's plan to issue domestic shares and overseas listed foreign shares at its establishment is carried out within 15 months as of the date of approval of the securities regulatory authorities of the State Council;

(3) where the Company's shares held by promoters are converted to overseas listed foreign shares upon approval by the State Council or the approving authority delegated by it, and are listed and traded on overseas stock exchanges.

Chapter 10 The Board

Section 1 Directors

Article 91 Directors shall be elected or replaced at the shareholders' general meetings with a term of office of 3 years. Upon expiry of the term of office, a director shall be eligible to offer himself for re-election and reappointment.

Any person appointed by the Board to fill a casual vacancy or as an addition to the Board shall hold office until the Company's next annual general meeting and that person shall then be eligible for re-election and reappointment.

Subject to the relevant laws and administrative regulations and without prejudice to any potential contractual claim, the shareholders' general meeting may by ordinary resolution remove any director before the expiration of his term of office.

A written notice of the intention to propose a candidate for election as a director and a written notice showing such candidate is willing to be elected shall be given to the Company after the issue of notice of general meeting in relation to election of such director, and in any event at least 7 days before the date of the general meeting. The period of the above written notice shall be no less than 7 days.

Article 92 A director may resign prior to the expiration of his term of office. A director who resigns shall submit to the Board a written resignation letter.

Upon submission of a resignation or the expiry of the term of office, a director's confidentiality obligations in respect of commercial secrets of the Company shall remain effective after the termination of his tenure until such secrets have become public information.

Article 93 Any director who has withdrawn from office without permission prior to the expiration of his term of office, causing a loss to be incurred to the Company, shall be liable for compensation of such loss.

Article 94 A director shall be deemed as unable to perform his duties if he fails to attend two consecutive meetings of the Board in person without appointing another director as proxy to attend the meetings of the Board on his behalf, and the Board may propose to the shareholders' general meeting that such director be removed.

Article 95 The Company shall have independent directors. Except as otherwise provided in this section, the provisions relating to the qualifications and obligations of directors in Chapter 14 of the Articles shall apply to independent directors.

Article 96 If the term of office of a director expires but re-election is not made forthwith, or the members of the Board fall below the quorum resulting from the resignation of a director during his term of office, such director shall continue to perform his duties as director pursuant to the relevant laws, administrative regulations and the Articles until a new director is elected.

Section 2 The Board

Article 97 The Company shall establish a Board. The Board shall comprise 9 directors, including 4 independent directors. Independent directors may report the relevant state of affairs directly to the shareholders' general meeting, the securities regulatory authorities of the State Council and other relevant departments.

The addition of directors shall be approved by special resolution in the shareholders' general meeting. The number of independent directors shall, at all times, be no less than 4.

The Board shall have one chairman and one vice chairman. The chairman and vice chairman of the Board shall be elected or removed by more than one half of all directors. The term of office of the chairman and vice chairman shall be 3 years and is renewable upon re-election.

A director is not required to hold any shares in the Company.

The number of persons holding office as chairman, vice chairman and executive directors of the controlling shareholder while also holding office as chairman, vice chairman and executive directors of the Company shall not exceed 2.

Article 98 The Board shall exercise the following functions and powers:

(1) to convene the shareholders' general meeting, to propose at the shareholders' general meeting to pass resolutions on the relevant matters and report its work to the shareholders' general meeting;

(2) to implement the resolutions of the shareholders' general meetings;

(3) to determine the operation plans and investment plans of the Company;

(4) to formulate the annual financial budget and the final account statement of the Company;

(5) to formulate the profit distribution plan and the plan for recovery of losses of the Company;

(6) to formulate proposals for increases or reductions of the Company's registered capital and for the issue of corporate debentures or other securities by the Company and listing of the Company;

(7) to formulate proposals for the acquisition or disposal of material assets, repurchase of the Company's shares, and the merger, separation, dissolution or change of the form of the Company;

(8) to decide on the establishment of the Company's internal management structure;

(9) to nominate, appoint or dismiss the Company's general manager, chief financial officer and secretary of the Board, and decide on matters relating to their remuneration; and to appoint or dismiss vice general managers and other senior management officers of the Company pursuant to the nominations of the Nomination Committee or general manager and decide on matters relating to their remuneration;

(10) to decide on the proposals for salaries, welfare, and incentive programs for the Company's staff;

(11) to approve the appointment or replacement of directors and supervisors representing shareholders of the Company's wholly-owned subsidiaries, the appointment, replacement or nomination of shareholder representatives, directors (candidates) and supervisors representing shareholders (candidates) of the Company's controlled subsidiaries and associated companies;

(12) to formulate the Company's basic management system;

(13) to formulate proposals for amendment to the Articles;

(14) to determine the establishment of the Company's domestic or overseas branch offices;

(15) to decide on matters such as the merger, division or reorganization of the Company's wholly-owned subsidiaries and controlled subsidiaries;

(16) to determine the establishment of special committees under the Board, and to appoint or remove its person-in-charge;

(17) to propose at general meetings a resolution in respect of candidates for independent directors and replacement of independent directors;

(18) to propose at general meetings for the appointment, renewal or dismissal of accountants' firm conducting auditing for the Company;

(19) to hear the work report and inspect the work of the general manager;

(20) to manage matters relating to information disclosure by the Company;

(21) to formulate the share incentive scheme;

(22) save as otherwise required to be decided by the shareholders' general meeting under laws and regulations and the Articles, the Board exercises its power to make decisions on external investments (including capital increase and equity transfer of the invested enterprises), financing, risk management and trust management, external guarantees, etc.;

(23) to decide on other major affairs of the Company, save for matters to be resolved at general meetings as required by the Company Law and the Articles;

(24) to decide on the Company's risk management system, including risk assessment, financial control, internal audit and legal risk control, and supervise the implementation of the system;

(25) to exercise other functions and powers as granted by the Articles and shareholders' general meetings of the Company;

(26) to conduct other matters as required by PRC laws and regulations.

Except for the matters specified in subparagraphs (6), (7) and (13) which shall be passed by two-thirds or more of the directors, the resolutions of the Board in respect of any other aforesaid matters may be passed by half or more of all directors.

The Board shall establish 5 special committees, namely the Strategy and Development Committee, the Operation and Risk Management Committee, the Audit Committee, the Nomination Committee and the Remuneration Committee, the personnel composition and terms of reference of which shall be resolved separately by the Board. Where necessary, the Board may establish other special committees. These special committees are ad hoc committees under the Board which provide advice or advisory opinions for the Board on material decisions. The special committees shall not make any decision in the name of the Board. However, the committees may exercise decision-making power in respect of the authorized matters in accordance with a special power given by the Board. The duties of the five special committees are as follows:

(1) the main duties of the Strategy and Development Committee shall include: researching and formulating the strategy and business development of the Company, including the medium to long term plans and submitting it to the Board for approval; supervising the implementation of the Company's strategic planning and strategic management and submitting an assessment report to the Board; researching and analyzing major issues encountered by the Company in the course of its development and submitting a research report to the Board; handling other matters as authorized by the Board; and other duties as required under the terms of reference of the Strategy and Development Committee.

(2) the main duties of the Operation and Risk Management Committee shall include: supervising the execution of the Company's annual business plan and budget; reviewing and evaluating the progress of any major investments, operations and major business; considering the decision making standards and mechanisms as regards major operating decisions, major risks, major events and major business processes and the risk assessment report of major decisions; establishing sound and comprehensive risk management and internal control procedures and ensuring its effective implementation; examining, approving or verifying the matters regarding investment, financing and external transactions contracts submitted by the general manager pursuant to the power granted by the Board; handling other matters as authorized by the Board; and other duties required under the terms of reference of the Operation and Risk Management Committee.

(3) the main duties of the Audit Committee shall include: making recommendations in on the appointment and removal of intermediaries such as accounting firms as well as their remuneration; auditing the Company's financial reports, considering the Company's accounting policies and changes thereof and giving advice to the Board; making recommendations to the Board in respect of the appointment or removal of the person-in-charge of its internal auditing department; supervising the formulation and implementation of its internal auditing system; evaluating and supervising the integrity and operational effectiveness of corporate auditing system; supervising, assessing and checking the integrity and operational effectiveness of the Company's risk management and internal control system and reporting the same to the Board; maintaining good communication with the Supervisory Board and internal and external auditing departments of the Company; and other duties required under the terms of reference of the Audit Committee.

(4) the main duties of the Nomination Committee shall include: nomination of the Company's general manager, vice general manager and chief financial officer and introducing candidates with special talents into the Company; studying and reviewing the selection standards and procedures for appointing the senior management of the Company, heads and deputy heads of business and functional departments of the Company and the chairman, directors, supervisors, general managers and vice general managers appointed to wholly-owned subsidiaries and controlled subsidiaries of the Company, and giving recommendations to the Board; and other duties required under the terms of reference of the Nomination Committee.

(5) the main duties of the Remuneration Committee shall include: developing proposals for the remuneration, appraisal and incentive programs in respect of the senior management personnel, heads and deputy heads of business departments and functional departments of the Company; preparing the proposals for the remuneration, appraisal and incentive programs in respect of the chairman, directors, supervisors, general managers and vice general managers designated by the Company in its wholly-owned subsidiaries and controlled subsidiaries; studying income distribution policies and programs for the Company's employees and giving advice; and other duties required under the terms of reference of the Remuneration Committee.

Article 99 The Board shall not, without the prior approval of shareholders' general meeting, dispose or agree to dispose, of any fixed assets of the Company of which the expected value in addition to that of the fixed assets that have been disposed of within 4 months immediately preceding the disposition proposal exceeds 33% of the value of the Company's fixed assets as shown in the latest balance sheet reviewed in the shareholders' general meeting.

For the purposes of this Article, a disposition of fixed assets includes certain transfer of interests in assets but does not include providing guarantee with fixed assets.

The validity of a disposition transaction by the Company of fixed assets shall not be affected by the violation of the first paragraph of this Article.

Prior to the decision-making in respect of any market development, merger and acquisition or investment in any new sector, the investment amount or assets amount of which accounts for 10% or more of the total asset value of the Company, the Board shall engage consultants to give expert opinions that will form the key basis for its decision.

Article 100 The chairman of the Board shall exercise the following functions and powers:

(1) to preside over the shareholders' general meetings and to convene and preside over meetings of the Board;

(2) to examine the implementation of the resolutions of the Board;

(3) to organize the formulation of regulations on the operation of the Board, and to coordinate the operation of the Board;

(4) to put forward a name list of the proposed candidates for the Company's general manager and chief financial officer;

(5) to hear regular or non-regular performance reports on the Company's senior management, and give opinions guiding the execution of board resolutions;

(6) to exercise special disposal powers to handle corporate affairs in compliance with legal requirements and in the interests of the Company in case of an event of force majeure or an emergency that precludes the convening of a board meeting on a timely basis, and provide post-event reports to the Board;

(7) to sign the Company's share certificates, debentures and other important documents;

(8) to represent the Company in signing important legally binding documents with third parties;

(9) to be responsible for liaising with the relevant state-owned assets authorities on behalf of the Board;

(10) to exercise any other functions and powers conferred by laws and regulations, the Articles or resolutions of the Board.

In the event that the chairman of the Board is unable to exercise and perform his powers and duties, the chairman may designate the vice chairman to exercise and perform such powers and duties on his behalf. In the event that the vice chairman is unable or fails to perform his duties, a director jointly elected by more than half of all the directors may perform such duties.

The Board may, if necessary, authorize the chairman of the Board to perform part of the duties of the Board when it is in recess.

Article 101 The Board shall hold at least four regular meetings every year, and notice of a regular meeting shall be given to all the directors and supervisors 14 days before the date of meeting. Board meetings shall be convened by the chairman of the Board.

In any of the following circumstances, the chairman shall convene an extraordinary meeting of the Board within ten days upon receipt of the proposal:

(1) as proposed by shareholders representing one-tenth or more of the voting rights;

(2) as proposed jointly by one-third or more of the members of the Board;

(3) when deemed necessary by the chairman of the Board;

(4) as proposed by two or more independent directors;

(5) as proposed by the Supervisory Board;

(6) as proposed by the general manager.

Article 102 The time limit and means of notification of convening a board meeting and extraordinary board meeting are as follows:

Notice of a regular meeting shall be given to all the directors, supervisors and the general manager 14 days before the date of meeting. Notice of an extraordinary meeting shall be given to all the directors, supervisors and the general manager 5 days before the date of meeting. The office of the Board shall send the written notice of meeting affixed with its seal to all the directors, supervisors and the general manager by hand, fax, e-mail or other means. Where the notice is not served by hand, telephone acknowledgement and records shall be made accordingly.

In emergency situations where an extraordinary meeting needs to be convened as soon as possible, notice of the meeting may be given by telephone or by other means of verbal communication at any time. The convener shall provide an explanation for such action at the meeting.

Article 103 Notice of meeting shall be deemed to have been issued to a director if he is present at the meeting and does not raise any issue of non-receipt of such notice prior to or at the time of his arrival at the meeting.

A regular or extraordinary board meeting can be held by way of teleconference or held through other telecommunication devices. As long as such devices enable clear communication among all directors, all directors participating shall be deemed as present in the meeting.

Article 104 Meetings of the Board shall be held only if more than half of the directors are present.

Each director shall have one vote only. Except for provided in laws, administrative regulations and the Articles, resolutions of the Board shall be passed by a majority vote of all directors.

In the event of a tie of votes cast for a resolution, the chairman shall be entitled to an additional vote.

A director shall not vote (or be counted in the quorum at a meeting) on any resolution relating to any contract or arrangement or other proposal in which he or any of his associates has an interest which (taken together with any interest of any of his associates) is to his knowledge a material interest and, if he purports to do so, his vote shall not be counted, unless otherwise provided by the laws, administrative regulations, the relevant regulatory rules or regulations.

Article 105 Directors shall attend meetings of the Board in person. In the event of a director is unable to attend a meeting in person for any reason, he may appoint in writing another director to attend the meeting on his behalf. The power of attorney shall specify the scope of authorization.

The proxy shall exercise the rights of a director within the scope of the authorization. A director failing to attend the board meeting in person or by proxy shall be deemed as having waived his voting rights at such meeting.

Article 106 All directors shall be notified of all material matters to be resolved at the Board meeting at the time required by the Articles and be provided with sufficient information strictly in accordance with the procedures as stipulated. Directors are entitled to request supplementary information. When more than one-fourth of directors or more than two independent directors consider the information provided is not sufficient or where an informed judgment cannot be made due to other reasons, they may jointly propose to postpone the convention of the Board meeting or to postpone the discussion of certain matters. The Board should accept such proposal.

Resolutions in respect of connected transactions of the Company made by the Board shall not come into force unless it is signed by independent directors.

Article 107 The Board may accept the Board meetings in the form of written resolutions in lieu of meetings on site. However, draft motions of the meeting must be delivered to each director by hand, post, telegraph, fax or e-mail. After the Board has delivered the motion to all directors and that the number of directors giving consent and signature to the motion has reached the quorum, such motion, if delivered to the secretary of the Board by means of methods referred to above, shall become a board resolution.

Article 108 The Board shall keep meeting minutes of the resolutions on the matters considered at meetings. The meeting minutes of each meeting of the Board shall be provided to all the directors for review as soon as possible. Those directors who wish to make supplementary revisions on the meeting minutes shall report their written opinions on the revisions to the chairman of the Board within one week after receipt of the minutes of such meeting. After the meeting minutes are finalized, the attending directors and the recorders shall sign on the minutes of such meeting. The meeting minutes of each meeting of the Board shall be kept in the domicile in the PRC for record, and the complete copies shall be delivered to each director as soon as possible. Directors shall undertake the responsibilities for the resolutions of the Board. In the event that any resolution of the Board is in breach of laws, administrative regulations or the Articles, which causes severe loss for the Company, those directors voting for such resolution shall be held liable for such losses. However, where any director has been proved to have expressed dissenting opinions on the voting on such resolution which have been recorded in the meeting minutes, such director may be exempted from such liability.

Chapter 11 Secretary of the Board of the Company

Article 109 The Company shall have a secretary of the Board. The secretary of the Board is a member of the senior management of the Company.

Article 110 The secretary of the Board of the Company shall be a natural person with the requisite professional knowledge and experience, and shall be nominated by the chairman and appointed or removed by the Board. His primary duties include:

(1) ensuring that the Company has complete organizational documents and records; keeping and managing shareholders' information; assisting the directors in addressing the routine tasks of the Board, keeping the directors informed and alerted about any regulations, policies and other requirements of domestic and foreign regulators concerning operations of the Company and ensuring they understand the above matters; assisting the directors and the general manager observe domestic and foreign laws and regulations as well as the Articles and other related regulations when performing their duties and powers;

(2) organizing and arranging for the Board meetings and general meetings, preparing meeting materials, handling relevant meeting affairs, being responsible for keeping minutes of the meetings and ensuring their accuracy, keeping meeting documents and minutes and taking initiative to keep abreast of implementation of relevant resolutions. Any important issues occurring during the implementation shall be reported and relevant proposals shall be put forward to the Board;

(3) ensuring the material matters resolved by the Board of the Company to be carried out strictly in accordance with the procedures as stipulated; according to the requirements of the Board, participating in the consultation and analysis of the matters to be considered by the Board and offering relevant opinions and suggestions; handling the day-to-day affairs of the Board and its committees as authorized;

(4) as the contact person of the Company with securities regulatory authorities, being responsible for preparation and timely submission of the documents as required to the regulatory authorities, and for accepting and organizing the implementation of any tasks from the regulatory authorities;

(5) being responsible for coordinating and organizing disclosure of information of the Company, establishing and improving the information disclosure system, participating in all meetings of the Company involving information disclosure, and keeping informed of the material operational decisions and relevant information of the Company in a timely manner;

(6) being responsible for keeping price-sensitive information of the Company confidential and working out effective and practical confidentiality systems and measures. Where there is any disclosure of price-sensitive information of the Company due to any reason, necessary remedial measures shall be taken; timely explanation and clarification shall be made; and relevant reports shall be submitted to the stock exchange of the place where the Company's shares are listed and the CSRC;

(7) being responsible for coordinating and organizing marketing activities, coordinating reception of visitors, handling the investor relations, keeping in touch with investors, intermediaries and news media; coordinating replies to inquiries from the public, and ensuring investors to obtain the information disclosed by the Company in a timely manner; organizing the preparation of the Company's domestic and overseas marketing and promotion activities, preparing summary reports on marketing and important visits, and organizing submission of the reports to the CSRC;

(8) being responsible for managing and keeping the materials in relation to register of members, directors' register, records of the Company's shares held by substantial shareholders and directors and the list of the beneficial owners of the outstanding bonds of the Company; keeping the Company's seal and developing sound management measures of the Company's seal;

(9) ensuring the proper maintenance of the Company's register of members, so as to ensure the persons who are entitled to obtain the relevant records and documents of the Company are able to obtain the same on a timely basis;

(10) assisting directors and the general manager in duly complying with the domestic and foreign laws, regulations, the Articles and other provisions in the course of discharging their duties, and upon becoming aware that the Company has passed or may pass resolutions which are in breach of relevant regulations, being obliged to immediately remind the Board, and being entitled to report such facts to the CSRC and other regulatory authorities;

(11) coordinating the provision of relevant information necessary for the Company's Supervisory Board and other auditing authorities to discharge their duties; and assisting in carrying out investigations on the performance of the chief financial officer, directors and the general manager of the Company of their fiduciary duties;

(12) being responsible for formulating the budget of outlay of the Board;

(13) performing other duties and powers as conferred by the Board, as well as other functions and powers as required by the regulatory authority of the place where the Company's shares are listed.

Article 111 A director or another member of senior management of the Company may concurrently act as the secretary of the Board. An accountant of the accounting firm appointed by the Company and a management personnel of the controlling shareholder shall not concurrently act as the secretary of the Board.

Where the secretary of the Board of the Company is acted by a director concurrently, an action that shall be performed by a director and the secretary of the Board separately shall not be made by the concurrent director and the secretary of the Board in his dual status.

Chapter 12 General Manager, Operation and Management Organs of the Company

Article 112 The Company shall have one general manager, who shall be engaged or removed by the Board. The Company shall have certain vice general managers, who shall be nominated by the Nomination Committee of the Board or the general manager and engaged or dismissed by the Board. An executive director may act concurrently as the general manager, the vice general manager or other senior management officers.

Article 113 General manager of the Company shall be responsible for the Board and exercise the following functions and powers:

(1) to lead the production, operation and management of the Company, and report his works to the Board;

(2) to organize the implementation of the resolutions of the Board, the Company's annual business plans and investment plans;

(3) to prepare the Company's annual budgets and final accounts, and to provide recommendations to the Board;

(4) to formulate the plans for merger, division or reorganization of the wholly-owned subsidiaries and controlled subsidiaries of the Company;

(5) to prepare plans for the establishment of the Company's basic management system and the internal management structure;

(6) to prepare plans for the establishment of domestic and overseas branches of the Company;

(7) to formulate the specific rules and regulations of the Company;

(8) to propose to the Board on the appointment or removal of the vice general managers and other senior management officers of the Company;

(9) to appoint or remove the management personnel, except for those shall be appointed or removed by the Board;

(10) to formulate the remunerations, benefits and incentive programs, as well as the appointment and removal of the Company's employees;

(11) to propose to convene an extraordinary board meeting when emergency occurs;

(12) to determine the plans for the establishment of branches of the wholly-owned subsidiaries and controlled subsidiaries of the Company;

(13) to determine on investment, financing, contracts and transactions of the Company within the scope of authorization of the Board;

(14) to exercise other functions and powers conferred by the Articles and the Board.

The vice general managers shall assist the general manager in his works and exercise certain functions and powers entrusted by the general manager.

Article 114 The general manager of the Company may attend the board meetings and shall not have voting right if he is not a director.

Article 115 The general manager of the Company shall perform his functions and powers in accordance with the laws, administrative regulations and the Articles to fulfill his duties in good faith and diligence. The general manager of the Company shall not exploit his position to accept bribes or other illegal income or expropriate the Company's properties.

Article 116 The Company shall have one chief financial officer, who shall be appointed or removed by the Board. The chief financial officer shall be responsible for the Board and the general manager, and exercise the following functions and powers according to their instructions:

(1) to manage comprehensively the financial work of the Company;

(2) to put forth proposals for the establishment of the accounting structure of the Company, and nominate candidates of head of finance department of the Company as well as of finance managers designated in its wholly-owned subsidiaries and controlled primary subsidiaries;

(3) to audit the operational expenses and administrative expenses of the Company;

(4) to prepare the annual budgets and final accounts;

(5) to exercise other functions and powers conferred by the Board and the general manager.

Chapter 13 Supervisory Board

Article 117 The Company shall establish the Supervisory Board, which shall exercise its supervisory powers in accordance with the provisions of the laws, administrative regulations and the Articles.

Article 118 The Supervisory Board shall be composed of 3 supervisors, one of whom shall act as the chairman of the Supervisory Board. The term of office of supervisors shall be 3 years, renewable upon re-election and re-appointment.

The appointment and removal of the chairman of the Supervisory Board shall be subject to the approval of not less than two-thirds of its members by voting.

Article 119 Members of the Supervisory Board shall be composed of two shareholder representatives and one staff representative. The shareholder representatives shall be elected and removed by shareholders in shareholders' general meeting, while the staff representative shall be elected and removed by employees of the Company in the employees' general meetings, the assembly of employees and other democratic elections.

More than half of the members of the Supervisory Board should be external supervisors (i.e. supervisors not holding any positions in the Company, including shareholder representative supervisors, same hereinafter). External supervisors shall have authority to report separately to the shareholders' general meeting on the honesty and diligence of the senior management officers of the Company.

Article 120 Directors and other senior management officers of the Company shall not concurrently act as supervisors.

Article 121 The Supervisory Board shall be responsible for the shareholders' general meeting and exercise the following functions and powers:

(1) to supervise the directors, the general manager and other senior management officers if they violate the laws, administrative regulations and the Articles in the execution of their duties, and to propose dismissal of any directors and senior management officers who violate the laws, administrative regulations, the Articles of the Company or any resolutions of shareholders' general meetings;

(2) to demand rectification from a director and other senior management officers when the acts of such persons prejudice the Company's interest;

(3) to examine the Company's financial accounts;

(4) to propose to convene an extraordinary general meeting and to convene and preside over the shareholders' general meeting when the Board fails to perform its duties of convening and presiding over the shareholders' general meetings under the Company Law;

(5) to put forth proposals at the shareholders' general meeting;

(6) to propose to convene an extraordinary board meeting;

(7) to bring an action against a director and senior management officer in accordance with Article 152 of the Company Law;

(8) to exercise other functions and powers specified in the laws, administrative regulations and the Articles.

Supervisors may attend the board meetings as non-voting participants.

Article 122 The Supervisory Board shall convene at least one meeting every six months, which shall be convened by the chairman of the Supervisory Board. If the chairman of the Supervisory Board is unable to or fails to perform his duties, a supervisor jointly elected by more than half of all supervisors shall convene and preside over the meeting of the Supervisory Board.

The supervisors may propose to convene an extraordinary meeting of the Supervisory Board.

Notices of a regular meeting and an extraordinary meeting of the Supervisory Board shall be given in written form bearing the chop of the Supervisory Board 10 days and 5 days before the meeting date respectively. The notices of meeting shall be given to all supervisors by hand, facsimile, email or other means. If a notice is not given by hand, a subsequent telephone call shall be made for confirmation and corresponding records shall be made.

In case of emergency and when an extraordinary meeting of the Supervisory Board is required to be convened as soon as possible, the notice of such meeting may be given by telephone or other verbal means at any time provided that the convener of the meeting shall give relevant explanation at the meeting.

Article 123 The method for conducting businesses at the meetings of the Supervisory Board: each supervisor shall have one vote only and the resolutions shall be passed by open or written ballot.

The voting procedure: a supervisor may cast an affirmative, a negative or an abstention vote. Each attending supervisor shall indicate his intention by choosing one of the above. The chairman of the meeting shall request any supervisor who fails to choose any of the above or has chosen two or more of the above to vote again, and supervisor shall be regarded as having abstained from voting if he refuses to vote again. Any supervisor who leaves the meeting and does not return and has not voted by choosing any of the above shall be regarded as having abstained from voting.

Resolutions of the Supervisory Board shall only be passed by the affirmative votes of more than two-thirds of the members of the Supervisory Board.

The Supervisory Board shall record all decisions on matters discussed in the minutes. Supervisors who attended the meeting shall sign the minutes of the meeting and have the right to put down any explanatory notes to the speech made at the meeting. The minutes of the meeting of the Supervisory Board shall be kept in the domicile of the company.

Article 124 The Supervisory Board shall investigate on findings of the Company's abnormal operations, and hire law firms, accounting firms or other professionals to assist if necessary with the relevant expenses being paid by the Company.

Article 125 A supervisor shall carry out his duties honestly and faithfully in accordance with laws, administrative regulations and the Articles.

Chapter 14 Qualification and Obligations of Directors, Supervisors, General Managers and Other Senior Management Officers of the Company

Article 126 A person may not serve as a director, supervisor, general manager, or any other senior management officer of the Company if he falls in any of the following circumstances:

(1) a person without legal capacity or with restricted legal capacity;

(2) a person who has been sentenced to criminal punishment for corruption, bribery, infringement of property, misappropriation of property or sabotaging socialist market economic orders; or who has been deprived of his political rights for committing a crime, in each case where not more than five years have elapsed since the date of the completion of such punishment or deprivation;

(3) a person who is a former director, factory manager or manager of a company or enterprise which has entered into insolvent liquidation and he is personally liable for the insolvency of such company or enterprise, where not more than three years have elapsed since the date of the completion of the insolvency and liquidation of the company or enterprise;

(4) a person who is a former legal representative of a company or enterprise which had its business license revoked and had been ordered to wind up due to a violation of law and who incurred personal liability, where not more than three years has elapsed since the date of the revocation of the business license of the company or enterprise;

(5) a person who has a relatively large amount of debts due and outstanding;

(6) a person who is currently under investigation by the judicial authorities for violation of criminal law, and the legal procedures are pending;

(7) a person who, according to laws and administrative regulations, cannot act as a leader of an enterprise;

(8) a non-natural person;

(9) a person who is convicted of contravention of relevant securities regulations provisions by a relevant regulatory authority, and such conviction involves a fraudulent act or dishonesty, where not more than five years has elapsed since the date of the conviction;

(10) other circumstances provided for by relevant laws and regulations in the place where the Company's shares are listed.

Article 127 The validity of an act of a director, general manager, or other senior management officer on behalf of the Company is not, vis-a-vis a bona fide third party, affected by any non-compliance in his office, election or his qualification.

Article 128 In addition to obligations imposed by laws, administrative regulations or listing rules of the stock exchange on which the Company's shares are listed, each of the Company's directors, supervisors, general manager, and other senior management officers owes a duty to each shareholder, in the exercise of the functions and powers of the Company entrusted to him:

(1) not to cause the Company to exceed the scope of the business stipulated in its business license;

(2) to act honestly in the best interest of the Company;

(3) not to expropriate in any guise the Company's property, including (without limitation) usurpation of opportunities advantageous to the Company;

(4) not to expropriate the individual rights of shareholders, including (without limitation) rights to distribution and voting rights, save pursuant to a restructuring of the Company submitted to shareholders' general meeting for approval in accordance with the Articles.

Each of the directors, supervisors, general manager, and other senior management officers of the Company owes a duty, in the exercise of his powers or discharge of his duties, to exercise the care, diligence and skill that a reasonably prudent person would have exercised in comparable circumstances.

The Company may establish a necessary system of insurance for the liabilities of its directors, supervisors and senior management officers for the purpose of lowering the risk that may be incurred from regular performance of duties by such parties.

Article 129 Each of our directors, supervisors, general manager, and other senior management officers shall carry out his duties in accordance with fiduciary principle and shall not put himself in a position where his duties and his interests may conflict. This principle includes (without limitation) fulfilling the following obligations:

(1) to act honestly in the best interests of the Company;

(2) to exercise powers within the scope of his powers and not to exceed those powers;

(3) to exercise the discretion vested in him personally and not to allow himself to act under the control of another and, unless and to the extent permitted by laws, administrative regulations or with the informed consent of the shareholders given in shareholders' general meeting, not to delegate the exercise of his discretion;

(4) to treat shareholders of the same class equally and to treat shareholders of different classes fairly;

(5) except in accordance with the Articles or with the informed consent of shareholders given in shareholders' general meeting, not to enter into any contract, transaction or arrangement with the Company;

(6) without the informed consent of shareholders given in shareholders' general meeting, not to use the Company's property for his own benefit in any form;

(7) not to exploit his position to accept bribes or other illegal income or expropriate the Company's property by any means, including (without limitation) opportunities advantageous to the Company;

(8) without the informed consent of shareholders given in shareholders' general meeting, not to accept commissions in connection with the Company's transactions;

(9) to abide by the Articles, faithfully execute his official duties and protect the Company's interests, and not to exploit his position and power in the Company to advance his own private interests;

(10) not to compete with the Company in any form unless with the informed consent of the shareholders given in shareholders' general meeting;

(11) not to misappropriate the Company's funds, not to open accounts in his own name or other names for the deposit of the Company's assets or funds, not to lend the Company's funds to others, and not to provide a guarantee for a shareholder of the Company or other individual(s) with the Company's assets in breach of the Articles and without the consent of the shareholders' general meeting or the Board;

(12) unless with the informed consent of the shareholders given in shareholders' general meeting, to keep in confidence confidential information regarding the Company acquired by him in the course of and during his tenure and not to use the information other than in furtherance of the interests of the Company, save that disclosure of such information to the court or other governmental authorities is permitted if:

i. disclosure is required by law;

ii. disclosure is required for public interest;

iii. the interests of the relevant director, supervisor, general manager, and other senior management officer require disclosure.

Any gain arising from the breach of this Article by the personnel mentioned in this Article shall belong to the Company. Such personnel shall also be liable for compensation for any loss of the Company arising therefrom.

Article 130 Each director, supervisor, general manager, or other senior management officer of the Company shall not cause the following persons or institutions ("associates") to do what he is prohibited from doing:

(1) the spouse or minor child of that director, supervisor, general manager, or other senior management officer of the Company;

(2) a person acting in the capacity of trustee of that director, supervisor, general manager, or other senior management officer or any person referred to in the preceding paragraph (1) of this Article;

(3) a person acting in the capacity of partner of that director, supervisor, general manager, or other senior management officer of the Company or any person referred to in paragraphs (1) and (2) above of this Article;

(4) a company in which that director, supervisor, general manager, or other senior management officer of the Company, alone or jointly with one or more persons referred to in paragraphs (1), (2) and (3) above, or other directors, supervisors, general manager, and other senior management officers of the Company, have a de facto controlling interest; and

(5) the directors, supervisors, general managers, and other senior management officers of the controlled company referred to in paragraph (4) of this Article.

Article 131 The fiduciary duties of the directors, supervisors, general manager, and other senior management officers of the Company do not necessarily cease upon termination of their tenure. The duty to keep confidential trade secrets of the Company survives the termination of their tenure. The continuous period of other duties must be decided according to the principle of fairness, depending on the time lapse between the termination and the act concerned and the circumstances and conditions under which the relationships between them and the Company are terminated.

Article 132 The liabilities a director, supervisor, general manager or other senior management officer of the Company is held for the breach of a certain obligation may be exempted by an informed decision of the shareholders' general meeting, unless otherwise provided for in Article 51 of the Articles.

Article 133 Where a director, supervisor, general manager, or other senior management officer of the Company is in any way, directly or indirectly, materially interested in a contract, transaction or arrangement which are made or planned by the Company (other than his contract of service with the Company), he shall declare the nature and extent of his interests to the Board at the earliest opportunity, whether or not the contract, transaction or arrangement is otherwise subject to the approval of the Board.

A director shall not vote on any contract, transaction or arrangement in which such director has a material interest, and such director shall not be counted in the statutory quorum of the board meeting.

Unless the interested director, supervisor, general manager or other senior management officer discloses his interests to the Board in accordance with the first paragraph and the contract, transaction or arrangement is approved by the Board at a meeting in which such interested director, supervisor, general manager, or other senior management officer is not counted in the quorum present at the meeting and refrains from voting, the contract, transaction or arrangement in which that director, supervisor, general manager, or other senior management officer is materially interested is voidable at the instance of the Company except as against a bona fide party thereto acting without notice of the breach of duty by the interested director, supervisor, general manager, or other senior management officer.

A director, supervisor, general manager, or other senior management officer of the Company is deemed to be interested in a contract, transaction or arrangement in which an associate of him is interested.

Article 134 Where a director, supervisor, general manager or other senior management officer of the Company gives to the Board a general notice in writing before the Company's first consideration of entering into contracts, transactions and arrangements, stating that, by reason of the facts specified in the notice, he or she is interested in contracts, transactions or arrangements which may subsequently be made by the Company, such notice shall be deemed for the purposes of the preceding article to be a sufficient declaration of his interests, so far as the content stated in such notice is concerned.

Article 135 The Company shall not pay taxes for its directors, supervisors, general manager and other senior management officers by any means.

Article 136 The Company shall not directly or indirectly make a loan to, or provide any guarantee in connection with the making of a loan to the directors, supervisors, general manager or other senior management officers of the Company or its parent, or any of their respective associates.

However, the following transactions are not subject to such prohibition:

(1) the provision by the Company of a loan or a guarantee of a loan to a subsidiary of our Company;

(2) the provision by the Company of a loan or a guarantee in connection with the making of a loan or any other funds to any of our directors, supervisors, general manager, and other senior management officers to meet expenditure incurred by him for the purposes of the Company or for the purpose of enabling him to perform his duties, in accordance with the terms of an employment contract approved by the shareholders' general meeting; and

(3) the Company may make a loan to or provide a guarantee in connection with the making of a loan to any of the relevant directors, supervisors, general manager, and other senior management officers or their respective associates in the ordinary course of its business on normal commercial terms, provided that the ordinary course of business.

Article 137 A loan made by the Company in breach of the above provisions shall be forthwith repayable by the recipient of the loan regardless of the terms of the loan.

Article 138 A guarantee provided by the Company in breach of item (1) of Article 136 shall be unenforceable against the Company, unless:

(1) at the time when the loan was provided to an associate of any of the directors, supervisors, general manager, and other senior management officers of the Company or its parent, the lender did not know the relevant circumstances;

(2) the collateral provided by the Company has been lawfully disposed of by the lender to a bona fide purchaser.

Article 139 The aforesaid guarantee includes an undertaking or property provided to secure the performance of obligations by the obligor.

Article 140 In addition to any rights and remedies provided by the laws and administrative regulations, where a director, supervisor, general manager or other senior management officer of the Company is in breach of his duties to the Company, the Company has a right to:

(1) claim damages from the relevant director, supervisor, general manager, or other senior management officer in compensation for losses incurred by the Company as a result of his negligence;

(2) rescind any contract or transaction entered into by the Company with the director, supervisor, general manager or other senior management officer or with a third party (where the third party knows or should know that there is a breach of obligation by such director, supervisor, general manager, or other senior management officer);

(3) demand a surrender of profits made by the director, supervisor, general manager, or other senior management officer in breach of his duties;

(4) recover any funds received by the director, supervisor, general manager, or other senior management officer which should have been received by the Company, including (without limitation) commissions;

(5) demand return of the interest earned or which may have been earned by the director, supervisor, general manager, or other senior management officer on funds that should have been paid to the Company; and

(6) procure return of properties to the Company acquired by the director, supervisor, general manager, or other senior management officer in breach of his duties through legal procedure rulings.

Article 141 With the prior approval at a shareholders' general meeting, the Company shall sign written contracts with its directors and supervisors concerning his emoluments. Such emoluments include:

(1) emoluments in respect of his service as a director, supervisor, or other senior management officer of the Company;

(2) emoluments in respect of his service as a director, supervisor, or other senior management officer of a subsidiary of the Company;

(3) remuneration otherwise in connection with the provision of other services to manage the Company or any subsidiary thereof; and

(4) compensation for his loss of office or retirement as a director or supervisor.

Except for the aforesaid contracts, a director or supervisor shall not file any lawsuit against the Company for the benefits they shall obtain for the foregoing matters.

The Company shall, on a regular basis, disclose to its shareholders the emoluments received by the director, supervisor or senior management officer from the Company.

Article 142 In the contract for emoluments entered into by the Company with a director or supervisor, it shall be provided that such director or supervisor has the right to receive, in connection with the takeover of the Company and subject to the prior approval of the shareholders' general meeting, compensation or other payments for loss of office or retirement from office.

A takeover of the Company means either of the following circumstances:

(1) an offer is made to all shareholders of the Company;

(2) an offer is made such that the offeror will become the controlling shareholder of the Company. The controlling shareholder has the same meaning as ascribed to it in the Articles.

If the relevant director or supervisor does not comply with the above requirements, any sum received by the director or supervisor on account of the payment shall belong to those persons who have sold their shares as a result of the offer, and the expenses incurred by the director or supervisor in distributing that sum pro rata among those persons shall be borne by him and not deducted from the sum distributed.

Chapter 15 Financial and Accounting System

Article 143 The Company shall establish its financial and accounting system in accordance with the laws, administrative regulations and provisions formulated by the relevant department of the PRC.

Article 144 The Company adopts the calendar year as the accounting year, starting on January 1 and ending on December 31 of each calendar year.

The Company shall, upon termination of each fiscal year, prepare its financial report which is subject to the audit and verification in accordance with the laws.

The financial statements of the Company shall, in addition to being prepared in accordance with PRC accounting standards and regulations, be prepared in accordance with either international accounting standards, or that of the place outside the PRC where the Company's shares are listed. If there is any material difference between the financial statements prepared respectively in accordance with the two accounting standards, such difference shall be stated in the notes to the financial statements.

When the Company is to distribute its after-tax profits of the relevant financial year, the lower of the after-tax profits as shown in the two financial statements shall be adopted.

Article 145 The Board shall place before the shareholders at every annual general meeting such financial reports prepared by the Company as required by relevant laws, administrative regulations or regulatory documents issued by the local governments and competent authorities.

Article 146 The Company shall not maintain books of accounts other than the statutory ones. The Company's assets shall not be deposited in an account maintained in the name of any individual.

Article 147 The Company's financial reports shall be made available for shareholders' inspection at the Company 20 days before the date of every annual general meeting. Each shareholder shall be entitled to obtain a copy of the financial reports referred to in this Chapter.

The Company shall deliver by prepaid post the aforesaid reports to each holder of the Company's overseas listed foreign shares at the addresses specified in the register of members no later than 21 days prior to the date of the annual general meeting.

Article 148 The Company shall publish its financial reports twice every fiscal year, that is, the interim financial report shall be published within 60 days after the expiration of the first six months of each fiscal year and the annual financial report shall be published within 120 days after the expiration of each fiscal year.

Any interim results or financial information published or disclosed by the Company shall be prepared in accordance with PRC accounting standards and regulations, and also in accordance with either international accounting standards or that of the place outside the PRC where the Company's shares are listed.

Chapter 16 Profit Distribution

Article 149 Plan for profit distribution

When the Company is to allocate after-tax profits of the current year, 10% of its profits shall be allocated into the Company's statutory reserve fund. When the aggregate amount of the statutory reserve fund has exceeded 50% of the Company's registered capital, further appropriations are not required.

If the statutory reserve fund of the Company is insufficient to make up for the losses of the previous years, the profits of the current year shall be used to make up for such losses before being allocated to the statutory reserve fund in accordance with the preceding paragraph.

After allocation of statutory reserve fund from its after-tax profits, the Company may also make appropriations to its discretionary reserve fund from such remaining profits by resolutions of the shareholders' general meeting.

The remaining after-tax profits after being used to make up for losses and allocated to reserve funds are available for distribution by the Company to its shareholders in proportion of their shareholdings in accordance with the resolution of the shareholders' general meeting.

In the event that the shareholders' general meeting has violated the aforesaid provisions, resulting in distribution of profits to shareholders prior being used to make up for losses and allocated to the statutory reserve fund, the shareholders shall return to the Company such profits distributed.

The shares held by the Company itself are not qualified for any profits distribution.

Article 150 The capital reserves fund shall include the following items:

(1) premium received in excess of the par value of the issued shares; and

(2) other revenue as required by the competent financial department of the State Council to be so included.

Article 151 The Company's reserve funds shall be used to cover its losses, expand the business and operation, or converted into the Company's capital. However, the capital reserve fund shall not be used to cover the Company's losses.

When the Company is to convert any statutory reserve fund to capital, the statutory reserve fund shall be maintained at a level no less than 25% of its registered capital prior to such conversion.

Article 152 The Company may distribute dividends in the form of (or a combination of both):

(1) cash;

(2) shares.

Article 153 Any amount paid up by shareholders in advance of calls on any share may carry interest but shall not entitle the holder of the shares to participate in respect thereof in any dividend subsequently declared.

Article 154 The Company shall appoint receiving agents for holders of the overseas listed foreign shares to receive, on behalf of such shareholders, dividends declared and other monies payable by the Company in respect of the overseas listed foreign shares, and to keep those monies for later payment to the related shareholders.

The receiving agents appointed by the Company shall be in accordance with the relevant requirements of the laws and the stock exchanges of the place where the Company's shares are listed.

The receiving agent appointed by the Company on behalf of holders of the overseas listed foreign shares listed on the SEHK shall be a company registered as a trust company under the Trustee Ordinance of Hong Kong.

Subject to relevant PRC laws and regulations, the Company may exercise the right to forfeit unclaimed dividends. However, such right shall be exercised only after the expiry of a period of six years or above commencing from the date of declaration of relevant dividends.

The Company is entitled to cease sending dividend warrants by post to certain holders of overseas listed foreign shares, while such power can only be exercised if such warrants have been left uncashed on two consecutive occasions. However, such power may be also exercised after the first occasion on which such a warrant is returned undelivered.

The Company shall have the right to sell the shares of shareholders of overseas listed foreign shares who are untraceable in a way deemed appropriate by the Board, provided that the following conditions are met:

(1) during a period of 12 years dividends in respect of the shares in question have been distributed at least three times and no dividend during that period has been claimed;

(2) on expiry of the 12 years the Company gives notice of its intention to sell the shares by way of an advertisement published in one or more local newspaper of the place where the Company's shares are listed and notifies the stock exchange where the Company's shares are listed.

Article 155 The cash dividends and other amounts payable by the Company to the holders of domestic shares shall be paid in Renminbi. The cash dividends and other amounts payable by the Company to the holders of overseas listed foreign shares shall be denominated and declared in Renminbi and paid in Hong Kong dollars. The foreign currency required for the payment of cash dividends and other amounts by the Company to the holders of overseas listed foreign shares shall be arranged in accordance with the provisions of the PRC in relation to foreign exchange administration.

Article 156 As for the cash dividends and other amounts to be paid in Hong Kong dollars, unless otherwise provided in relevant laws or administrative regulations, the Company shall adopt the average offer price of the relevant foreign exchange quoted by the People's Bank of China during the calendar week immediately before the date on which the dividends and other amounts are declared as the applicable exchange rate.

Chapter 17 Appointment of an Accounting Firm

Article 157 The Company shall appoint an independent accounting firm which is qualified under the relevant regulations of the PRC to audit the Company's annual financial reports and review the Company's other financial reports.

The first accounting firm of the Company may be appointed by the inaugural meeting of the Company before the first annual general meeting. The accounting firm so appointed shall hold office until the conclusion of the first annual general meeting.

Article 158 The accounting firm appointed by the Company shall hold office from the conclusion of the annual general meeting at which the appointment is made until the conclusion of the next annual general meeting.

Article 159 An accounting firm appointed by the Company shall have the following rights:

(1) to inspect the accounting books, records and vouchers of the Company at any time, and to request the directors, general manager or other senior management officers of the Company to provide relevant information and explanation;

(2) to request that the Company adopt all reasonable measures to obtain from its subsidiaries such information and explanation as required by the accounting firm for performing its duties;

(3) to attend the shareholders' general meeting, and to obtain such notice of the meeting or other information regarding the meeting as any shareholder is entitled to do so, and to speak at the shareholders' general meeting on matters involving it as the accounting firm employed by the Company.

The Company shall provide the appointed accounting firm with true and complete accounting vouchers, accounting books, financial accounting reports and other accounting information, and the Company shall not refuse to provide or conceal or falsify such documents.

Article 160 In case of any vacancy in the accounting firm, the Board may fill such vacancy in the office of the accounting firm before the convening of the shareholders' general meeting, but while any such vacancy continues and if the Company has other serving accounting firm, such accounting firm may still act on behalf of the Company.

Article 161 Regardless of what is stipulated in the contract concluded between an accounting firm and the Company, the shareholders' general meeting may, before the expiration of term of office for the accounting firm, decide to dismiss that firm by the adoption of an ordinary resolution. If such accounting firm has the right to claim compensation from the Company for reason of such dismissal, that right shall not be affected.

Article 162 The remuneration of an accounting firm or the manner in which such remuneration is to be decided shall be determined by the shareholders' general meeting.

Article 163 The Company's appointment, dismissal and non-reappointment of an accounting firm shall be resolved by shareholders' general meeting and be filed with the competent authorities for securities affair of the State Council.

The shareholders' general meeting shall abide by the following provisions when proposing to pass a resolution regarding the appointment of an accounting firm not currently serving the Company to fill the vacancy of an accounting firm, or the renewal of terms of service of an accounting firm appointed by the Board to fill the vacancy, or the dismissal of an accounting firm before the expiry of its term:

(1) the proposal in relation to the appointment, renewal or dismissal shall be sent prior to the issue of notice of shareholders' general meeting to the accounting firm to be appointed, the accounting firm to be dismissed or the accounting firm which has left its post during the accounting year.

An accounting firm leaving its post includes dismissal, resignation and retirement.

(2) in the event that an accounting firm leaving its post makes a statement in writing and requests the Company to inform its shareholders of such statement, unless the Company receives the statement too late, the Company shall adopt the following measures:

i. state on the notice issued for adoption of the resolution that an accounting firm about to leave its post has made a statement; and

ii. submit the copy of the statement as an appendix to the notice to the shareholders in the manner stipulated in the Articles.

(3) in the event that the statement of the accounting firm has not been dispatched in accordance with the provisions in paragraph (2) of this Article, the relevant accounting firm may request such statement to be read at the shareholders' general meeting, and may make further appeals.

(4) the accounting firm leaving its post shall be entitled to attend the following meetings:

i. the shareholders' general meeting at which its term of service would otherwise have expired;

ii. the shareholders' general meeting for filling the vacancy caused by its dismissal; and

iii. the shareholders' general meeting convened as a result of its voluntary resignation.

The accounting firm leaving its post shall be entitled to obtain all notices of the aforementioned meetings and other information relating to such meetings and shall also be entitled to present its views at the aforementioned meetings on matters in relation to its previous engagement as the accounting firm of the Company.

Article 164 If the Company proposes to remove the accounting firm or not to renew the appointment thereof, it should notify the accounting firm in advance, and the latter has the right to state its opinions to the shareholders' general meeting. Where the accounting firm resigns its office, it shall make clear to the shareholders' general meeting whether there has been any impropriety on the part of the Company.

(1) Any accounting firm may resign its office by depositing at the Company's legal residence a resignation notice which shall become effective on the date of such deposit or on such later date as may be stipulated in such notice. Such notice shall include the following:

i. a statement to the effect that there are no circumstances connected with its resignation which it considers should be brought to the notice of the shareholders or creditors of the Company; or

ii. a statement of any relevant situations.

(2) Upon receipt of the written notice as set out in paragraph (1) of this Article, the Company shall within 14 days send a copy of the notice to the relevant governing authority. If the notice contains a statement under subparagraph (ii) of paragraph (1), a copy of such statement shall be placed at the Company for shareholders' inspection. The copy of such statement shall also be sent by prepaid mail, to every holder of the overseas listed foreign shares of the Company at the address as recorded in the register of member of the Company.

(3) Where the accounting firm's notice of resignation contains a statement referred to in subparagraph (ii) of paragraph (1), the accounting firm may require the Board to convene a shareholders' extraordinary general meeting for the purpose of giving an explanation of the circumstances connected with its resignation.

Chapter 18 Notice

Article 165 Notices of the Company may be given in the following ways:

(1) by hand;

(2) by post;

(3) by facsimile or electronic mail;

(4) by posting on websites designated by the Company and the SEHK, subject to laws, administrative regulations and the listing rules of stock exchanges where the Company's shares are listed;

(5) by way of announcement;

(6) by any other means as agreed in advance by the Company or the notified party or as accepted by the notified party upon receipt of the notices;

(7) by any other means as recognized by the securities regulatory authorities of the places where the Company's shares are listed or as stipulated in the Articles.

Unless the context otherwise specifies, the "announcements" referred to in the Articles shall mean, in respect of announcements made to the holders of domestic shares or announcements to be published in the PRC as required by relevant requirements and the Articles, the announcements published in Chinese newspapers prescribed under the laws and administrative regulations of the PRC or designated by the securities regulatory authority of the State Council; in respect of announcements made to the holders of overseas listed foreign shares or announcements that are required to be made within Hong Kong in accordance with relevant regulations and the Articles, such announcements must be published on designated Hong Kong newspapers as stipulated under the listing rules of the SEHK.

Article 166 Unless otherwise provided in the Articles, the various ways of giving notices as specified in the preceding article shall apply to all notices of the shareholders' general meetings, meetings of the Board and the Supervisory Board convened by the Company.

Article 167 If the notice is sent out by courier and the served party signs (or seals) on the service receipt, the date when the served party acknowledges the receipt of the notice shall be the date of service. If the notice is sent out by post, the 48th hour after the date when the notice is delivered to the post office shall fall within the date of service. If the notice is sent out by facsimile or electronic mail or by posting on websites, the date of sending out shall be the date of service. If the notice is sent out as an announcement, the date of the publication of the announcement for the first time shall be the date of service. Such announcement shall be published on newspapers that are in compliance with relevant regulations.

Article 168 Where the listing rules of the stock exchanges where the Company's shares are listed requests that the Company deliver, post, distribute, issue, publish or by any other means to provide relevant documents of the Company in both English and Chinese, if the Company has made appropriate arrangements to determine whether its shareholders desire to receive the English version only or the Chinese version only, and to the extent permitted by and in accordance with applicable laws and regulations, the Company may, in accordance with the preference expressed by its shareholders, deliver only the English version or only the Chinese version to the shareholders.

Chapter 19 Merger and Division of the Company

Article 169 A proposal for merger or division of the Company shall be proposed by the Board of the Company, and shall be passed according to the procedures stipulated by the Articles and relevant approval formalities shall be handled according to law. Shareholders who object to the proposal for merger or division of the Company shall be entitled to require the Company or the shareholders who consent to such proposal to purchase their shares at a fair price. The content of the resolution of merger or division of the Company shall be compiled in a special document for inspection by shareholders.

The aforesaid documents shall be delivered by post to holders of overseas listed foreign shares.

Article 170 The merger of the Company may take the form of either merger by absorption or merger by new establishment.

In the event of a merger, the parties to the merger shall enter into a merger agreement, and prepare a balance sheet and a property inventory. The Company shall notify its creditors within 10 days from the date on which the resolutions approving the merger are passed and, within 30 days, make in newspapers announcements of the merger.

When the Company is merged, the surviving company or the newly established company resulting from the merger shall succeed to the claims and debts of each party to the merger.

Article 171 When the Company is divided, its properties shall be divided up accordingly.

In the event of a division, the Company shall prepare balance sheets and lists of properties. The Company shall notify its creditors within 10 days from the date on which the resolutions approving the division are passed and, within 30 days, make in newspapers announcements of the division.

Unless otherwise agreed in writing between the Company and its creditors in relation to the repayment of debts before the division, the successor companies after the division shall jointly assume the liabilities of the Company incurred before such division.

Article 172 In the event of a merger or division of the Company, alterations in the registered matters of the Company shall be registered at the company registration authorities in accordance with law; in the event of a dissolution of the Company, the cancellation of registration shall be made in accordance with law; in the event of establishment of a new company, the registration of incorporation thereof shall be made in accordance with law.

Chapter 20 Dissolution and Liquidation of the Company

Article 173 The Company shall be dissolved in any of the following circumstances:

(1) a special resolution for dissolution is passed at shareholders' general meeting;

(2) dissolution is necessary due to a merger or division of the Company;

(3) the Company's business license is revoked, and the Company is ordered to close down or eliminated in accordance with law;

(4) the Company is ordered to close down due to breach of laws or administrative regulations;

(5) where the Company suffers significant hardship in its operation or management so that the interests of its shareholders are subject to significant loss if the Company continues to exist, and that the situation cannot be resolved by any other means, the shareholders holding 10% or more of the voting rights of all the shareholders of the Company may petition the People's court to dissolve the Company.

Article 174 Where the Company is dissolved pursuant to paragraphs (1), (3) and (5) of Article 173, a liquidation committee shall be set up, within 15 days from the date upon which the cause of dissolution arises, to carry out the dissolution of the Company. The composition of the liquidation committee shall be determined by directors or the shareholders' general meeting. In case no such committee is established to proceed with dissolution in time, the creditors may make application to the people's court for appointing relevant persons to form the liquidation committee for dissolution.

Article 175 Where the Board decides to liquidate the Company (due to causes other than where the Company has declared that it is insolvent), the Board shall, in its notice convening a shareholders' general meeting, declare that, after making full inquiry into the affairs of the Company, the Board is of the opinion that the Company will be able to repay its debts within 12 months after the commencement of the liquidation.

Upon passing of the resolution at the shareholders' general meeting for the liquidation of the Company, all functions and powers of the Board shall cease forthwith.

The liquidation committee shall act in accordance with the instructions of the shareholders' general meeting and report at least once a year to the shareholders' general meeting on the committee's receipts and payments, the business of the Company and the progress of the liquidation and to place a final report before the shareholders' general meeting on completion of the liquidation.

Article 176 The liquidation committee shall exercise the following functions and powers during the liquidation:

(1) to dispose of the Company's property and prepare a balance sheet and a property inventory;

(2) to give notices or publish announcements to the creditors;

(3) to deal with unsettled business in relation to the liquidation of the Company;

(4) to settle due taxes and taxes accrued during the liquidation;

(5) to settle claims and debts;

(6) to dispose of the Company's remaining assets after the discharge of its liabilities; and

(7) to participate in civil litigations on behalf of the Company.

Article 177 The liquidation committee shall notify creditors within 10 days from the date of its establishment and publish announcements in newspapers within 60 days. The creditors may declare their claims to the liquidation committee within 30 days from the date it receives the above notice or within 45 days from the date of announcement if no such notice is received.

When declaring the claims, the creditors shall specify relevant matters about the claims and provide evidences. The liquidation committee shall register such claims.

During the period of declaration of claims, the liquidation committee shall not repay any debts to the creditors.

Article 178 After the liquidation committee has liquidated the property of the Company and prepared a balance sheet and a property inventory, it shall formulate a liquidation scheme and report it to the shareholders' general meeting or relevant competent authorities for confirmation.

The assets of the Company shall be applied for liquidation in the following order: payment of liquidation expenses, salaries of the employees and social security expenses and statutory compensation, payment of outstanding taxes, and payment of the Company's liabilities.

The remaining property of the Company, after liquidation provided in the previous clause, shall be distributed to the shareholders according to classes and in proportion of shares held by each of the shareholder.

During the liquidation, the Company shall not carry out any new operating activity.

Article 179 Where after liquidating the property of the Company and preparing a balance sheet and a property inventory, if the liquidation committee finds that the property of the Company is insufficient to repay its debts, the liquidation committee shall immediately apply to the People's court for bankruptcy of the Company.

After a ruling is made by the people's court that the Company be declared bankrupt, the liquidation committee shall hand over the liquidation work to the people's court.

Article 180 Following the completion of the liquidation, the liquidation committee is to prepare a liquidation report, a statement of the income and expenses during the liquidation period and financial accounts, which are to be verified by PRC certified public accountants and then submitted to the shareholders' general meeting or the people's court for confirmation. The aforesaid documents are, within 30 days from the date of confirmation by the shareholders' general meeting or the people's court, to be lodged with the Company's registration authority for cancellation of its registration and a public announcement is to be made for the termination of the Company.

Chapter 21 Procedures for Amendments to the Articles

Article 181 The Company may amend the Articles according to the provisions of laws, administrative regulations and the Articles.

Article 182 The following procedures shall be followed when amending the Articles:

(1) The Board shall firstly adopt a resolution for amendments to the Articles and prepare a proposal for amendments to the Articles;

(2) The Board shall convene a shareholders' general meeting for voting on such proposal thereat;

(3) The shareholders' general meeting shall approve such proposal by special resolution;

(4) The Company shall report the proposal for amendments to the Articles approved at the shareholders' general meeting to the approving authority, which will become effective upon approval;

(5) The Company shall submit the amended Articles to the company registration authority for record.

Article 183 Amendments to the Articles which involve the contents of the Mandatory Provisions become effective upon approval by the companies approving department authorized by the State Council and securities committee of the State Council. Where amendments involve the registered particulars of the Company, application for alteration of registration is to be made in accordance with laws.

Chapter 22 Settlement of Disputes

Article 184 The Company follows the following rules of dispute resolution:

(1) Any dispute or claim of rights relating to the affairs of the Company and arising between holders of overseas listed foreign shares and the Company, or between holders of overseas listed foreign shares and directors, supervisors, general manager or any other senior management officers of the Company, or between holders of overseas listed foreign shares and holders of domestic shares, and arising as a result of the rights and obligations provided for in the Articles, Company Law, and relevant laws and administrative regulations, shall be referred to arbitration by parties involved.

Where a dispute or claim of rights referred to in the preceding paragraph is referred to arbitration, the entire claim or dispute must be referred to arbitration, and all persons who have a cause of action based on the same facts giving rise to the dispute or claim or whose participation is necessary for the resolution of such dispute or claim, where the persons being the Company or shareholders, directors, supervisors, general manager or any other senior management officers of the Company, shall comply with the arbitration.

Disputes in respect of the definition of shareholders and disputes in relation to the register of members need not be resolved by arbitration.

(2) A claimant may elect for arbitration to be carried out at either the China International Economic and Trade Arbitration Commission in accordance with its arbitration rules or the Hong Kong International Arbitration Center in accordance with its securities arbitration rules. Once a claimant refers a dispute or claim to arbitration, the other party must submit to the arbitral body elected by the claimant.

If the claimant elects for arbitration to be carried out at the Hong Kong International Arbitration Center, any party may request the arbitration to be conducted in Shenzhen in accordance with the securities arbitration rules of the Hong Kong International Arbitration Center.

(3) The resolution of any dispute or claim of rights referred to in paragraph (1) above by arbitration is subject to the PRC (excluding the Hong Kong Special Administrative Region, the Macau Special Administrative Region and Taiwan) laws, unless otherwise required by laws and administrative regulations.

(4) An arbitral award made by the arbitral body is final and binding on the parties.

Chapter 23 Supplementary Provisions

Article 185 The Company may be exempt from the disclosure or performance of related obligations in the event that the information of the Company is classified state information, commercial secrets or other circumstances as recognized by SEHK where the performance of such disclosure obligations may be in the breach of the PRC laws and regulations with respect to confidentiality or a detriment to the interest of the Company.

Article 186 In the Articles, the meaning of an "accounting firm" is the same as that of "auditors".

In the Articles, a "de facto controller" means a person who, though not a shareholder of the Company, is able to get the de facto control of the Company through investment relationships, agreement or other arrangements.

In the Articles, "no less than", "within" or "no more than" includes the underlying number, while "more than" or "beyond" excludes the underlying number.

Article 187 The Articles are written in Chinese. Should there be any discrepancies between the versions in other languages and the Chinese version, the Chinese version shall prevail.

Article 188 The power of interpretation of the Articles shall be vested in the Board.

Any matters not contained in the Articles shall be proposed by the Board at the shareholders' general meeting for approval.

中國機械設備工程股份有限公司
China Machinery Engineering Corporation
House No. 8, Street No. 41, F-7/1, Islamabad.Phone: +92 51 2652553; Fax: +92 51 2652550

TRANSLATION OF THE CERTIFICATE OF TAXPAYER

Certificate of Taxpayer

To NEPRA, Pakistan

1. Name of Taxpayer: China Machinery Engineering Corporation
2. Tax Number: 110104100000710
3. Duration of Checking: 1 January 2014 to 31 December 2014
4. Checking Results:

China Machinery Engineering Corporation (CMEC) is the taxpayer under Tax Number 11010410000710. Tax types include Corporate Tax and VAT.

Until now, there is no record of Overdue Declaration, Arrears, Penaltyof the Taxpayer during 1 January 2013 to 31 December 2014.

Enclosed is the original certificate issued by Beijing Xicheng Tax Authority.

Beijing Xicheng Tax Authority, China

Dated 14 January 2015

中國機械設備工程股份有限公司
China Machinery Engineering Corporation
House No. 8, Street No. 41, F-7/1, Islamabad.Phone: +92 51 2652553; Fax: +92 51 2652550

Translation of Cash Balance Sheet

To: NEPRA, Pakistan

It is hereby certified that there are balance of CNY194,074,118.68 as at 31st December 2014 under the following account being maintained in our bank:

1. Account Holder: China Machinery Engineering Corporation
2. Account No.: 340256012725
3. Bank: Bank of China, Beijing Lianhuahe Branch

Bank of China, Beijing Lianhuahe Branch

Date: 12 January 2015

HEAD OFFICE, BEIJING
No. 178 Guanganmenwai Street, Beijing 100055, ChinaPhone: +86 10 63268176 Fax: +86 10 63452186

账号 Account No. 340256012725　　账户名称 Account Name 中国机械设备工程股份有限公司　　开户行 Bank Name 中国银行北京莲花河支行　　起始日期 From(YYYYMMDD) 20141201 第 21 页/共 21 页 Page 21 of 21

币种 Currency 人民币(CNY)　　账户类型 Account Type 单位人民币活期一般账户存款　　承前页余额 Previous Page Balance 559,433,212.98　　截止日期 To(YYYYMMDD) 20141231 出账周期 Reconciliation Period 年

序号 No.	记账日 Bk.D.	起息日 Val.D.	交易类型 Type	凭证 Vou.	凭证号码/业务编号/用途/摘要 Vou. No./Trans. No./Details	借方发生额 Debit Amount	贷方发生额 Credit Amount	余额 Balance	机构/柜员/流水 Reference No.	备注 Notes
1	141230	141230	大额支付		HVPS313100018057 20141230000013107/转账		100,000,000.00	659,433,212.98	02241/9880809/161052135	中国机械设备工程股份有限公司/江苏银行股份有限公司北
2	141230	141230	收费	A022	001/TT020641400017O3/企业国际电讯费-国际发电	150.00		659,433,062.98	02064/3430518/162403646	
3	141230	141230	收费	A022	001/TT020641400017O3/对公汇出境外汇款电汇费	744.30		659,432,318.68	02064/3430518/162403646	
4	141231	141231	大额支付		HVPS313100018057 20141231000032O0/转款		100,000,000.00	759,432,318.68	02241/9880809/85150662	中国机械设备工程股份有限公司/江苏银行股份有限公司北
5	141231	141231	转账支出	3001	10401130104344O3	28,480,000.00		730,952,318.68	02064/3430518/85551285	中经东源进出口有限责任公司
6	141231	141231	转账支出	3001	10401130104344O2	13,900,000.00		717,052,318.68	02064/3430518/85714113	中经东源进出口有限责任公司
7	141231	141231	国内汇款	3001	10401130130176O5/D000345140071511/其他/还款		15,640,000.00	732,692,318.68	00345/3543044/121310873	中经东源进出口有限责任公司
8	141231	141231	转账支出	3001	10401130104344O4	500,000,000.00		232,692,318.68	02064/3430518/146282630	中国机械设备工程股份有限公司
9	141231	141231	大额支付		HVPS104100004345 20141231125694O5/转款 本部	100,000,000.00		132,692,318.68	02064/6393149/146829639	中国机械设备工程股份有限公司/江苏银行股份有限公司北
10	141231	141231	收费		对公跨行柜台转账汇款手续费	200.00		132,692,118.68	02064/6393149/146829639	
11	141231	141231	大额支付		HVPS671100000013 20141231010242O9/远期结汇		61,382,000.00	194,074,118.68	02241/9880809/155770519	中国机械设备工程股份有限公司/渣打银行(中国)有限公司

借方合计 Debit Total 642,381,094.30　　贷方合计 Credit Total 277,022,000.00　　本页余额 Current Page Balance 194,074,118.68　　本对账期末余额 Balance At the End of the Period 194,074,118.68

1. 余额前面标注"-"代表借方金额，没有标注的则代表贷方金额。"-" mark represents debit amount; otherwisely represents credit amount.　2. 对账单中如出现错误或遗漏情况，请于收到后的七日内通知我行，否则将视同此对账单无误。请妥善保管对账单，并在您的地址/联系电话发生变更时，及时书面通知我行。For any error or omission in this statement, please kindly notify within 7 days after receipt, otherwise it would be deemed as agreed. Please keep this statement properly and timely inform us with written notice of address or contact number change.

中國機械設備工程股份有限公司
China Machinery Engineering Corporation
House No. 8, Street No. 41, F-7/1, Islamabad.Phone: +92 51 2652553; Fax: +92 51 2652550

Expression of Interest to Provide Credit or Financing

Founded in 1978, China Machinery Engineering Corporation (CMEC) is the first large import & export company in China and has evolved into an internationally reputed and domestically leading engineering contractor mainly engaged in international projects, trade and investment. In 2012, CMEC was listed on the Hong Kong Stock Exchange.

The average turnover of CMEC stands at around US$ 3.5 billion in the last three years.

Since 1983, CMEC has completed over 10 power projects in Pakistan, with total installed capacity around 1.5 GW inclusive of Guddu Unit 4, Jamshoro Units 2, 3 and 4, Muzaffargarh Units 4, 5 & 6, and Saif Power. CMEC is currently executing the 4x245MW Neelum Jhelum Hydropower Project which is called the "Three Gorges" in Pakistan.

CMEC has obtained the Letter of Intent for setting up 1x300MW (net) Coal Fired Power Plant at Pind Dadan Khan of Salt Range, Punjab based on indigenous coal from Private Power & Infrastructure Board (PPIB) on 19th November 2014.

As this is one of the priority projects under the China Pakistan Economic Corridor, 40 engineers have been mobilized from China to work on the site for early preparation work of the power plant.

Estimated total project cost is around $588.98 million (including interests during construction and Sinosure insurance premium). As the sponsor, CMEC is under negotiation with the Export-Import Bank of China (China Eximbank), Industrial and Commercial Bank of China (ICBC), China Development Bank (CDB) for the project financing. As this is one of the priority projects under the China Pakistan Economic Corridor, the banks are very interested in providing financing for the project.

Enclosed is Financing Facility from ICBC.

Su Guanglei
Authorized Representative
China Machinery Engineering Corporation

HEAD OFFICE, BEIJING
No. 178 Guanganmenwai Street, Beijing 100055, ChinaPhone: +86 10 63268176 Fax: +86 10 63452186

ICBC 中国工商银行 北京市分行

INDUSTRIAL AND COMMERCIAL BANK OF CHINA BEIJING MUNICIPAL BRANCH

Bank statement

To: National Electric Power Regulatory Authority (NEPRA)

Dear Sirs,

We, Industrial and Commerical Bank of China, having our registered office at No.2 Fuxingmennan Street, Xichen District, Beijing, China, hereby certify that China Machinery Enginery Coporation (CMEC), No.178, Guang'anmenwai street, Xicheng District, Beijing, has maintained a well conducted account with us since 2010 and their dealings with us are satisfactory over the last 4 years. We have granted the company a credit line in aggregate amount USD 500,000,000.00 (Say US Dollar Five Hundred Million only), including Loan and letter of guarantee limit, valid until Jul. 17th, 2015.

The above information is given to you on a strictly private and confidential basis and without any responsibility on our part or our officers.

Yours faithfully,

For Industrial and Commercial Bank of China

KPMG
8th Floor, Prince's Building
10 Chater Road
Central, Hong Kong
P O Box 50
General Post Office
Hong Kong

Telephone +852 2522 6022
Fax +852 2845 2588
Internet kpmg.com/cn

Independent auditor's report to the shareholders of China Machinery Engineering Corporation

(Incorporated in the People's Republic of China with limited liability)

We have audited the consolidated financial statements of China Machinery Engineering Corporation (the "Company") and its subsidiaries (together the "Group") set out on pages 1 to 92, which comprise the consolidated and company balance sheets as at December 31, 2013, the consolidated statement of comprehensive income, the consolidated statement of changes in equity and the consolidated cash flow statement for the year then ended and a summary of significant accounting policies and other explanatory information.

Directors' responsibility for the consolidated financial statements

The directors of the Company are responsible for the preparation of consolidated financial statements that give a true and fair view in accordance with International Financial Reporting Standards issued by the International Accounting Standards Board and the disclosure requirements of the Hong Kong Companies Ordinance and for such internal control as the directors determine is necessary to enable the preparation of consolidated financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's responsibility

Our responsibility is to express an opinion on these consolidated financial statements based on our audit. This report is made solely to you, as a body, and for no other purpose. We do not assume responsibility towards or accept liability to any other person for the contents of this report.

We conducted our audit in accordance with Hong Kong Standards on Auditing issued by the Hong Kong Institute of Certified Public Accountants. Those standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the consolidated financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the consolidated financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the consolidated financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation of the consolidated financial statements that give a true and fair view in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by the directors, as well as evaluating the overall presentation of the consolidated financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

KPMG

Independent auditor's report to the shareholders of China Machinery Engineering Corporation

(Incorporated in the People's Republic of China with limited liability)

Opinion

In our opinion, the consolidated financial statements give a true and fair view of the state of affairs of the Company and of the Group as at December 31, 2013 and of the Group's profit and cash flows for the year then ended in accordance with International Financial Reporting Standards and have been properly prepared in accordance with the disclosure requirements of the Hong Kong Companies Ordinance.

KPMG

Certified Public Accountants
8th Floor, Prince's Building
10 Chater Road
Central, Hong Kong

March 24, 2014

Consolidated Statement of Comprehensive Income
For the year ended December 31, 2013
(Expressed in Renminbi unless otherwise stated)

	Note	2013 *RMB'000*	2012 *RMB'000*
Revenue	4	21,426,272	21,296,063
Cost of sales		(17,683,814)	(17,564,553)
Gross profit		3,742,458	3,731,510
Other revenue	5	12,350	11,985
Other income, net	6	353,476	10,130
Selling and marketing expenses		(1,157,660)	(1,086,621)
Administrative expenses		(556,996)	(478,253)
Other operating expenses		(65,476)	(125,509)
Profit from operations		2,328,152	2,063,242
Finance income		737,865	582,992
Finance expenses		(401,713)	(30,270)
Net finance income	7(a)	336,152	552,722
Share of profits less losses of associates		(199)	(86)
Profit before taxation	7	2,664,105	2,615,878
Income tax	8	(703,864)	(687,716)
Profit for the year		1,960,241	1,928,162
Other comprehensive income for the year:			
Items that will not be reclassified to profit or loss:			
Remeasurements of defined benefit obligations		21,710	-
Items that may be reclassified subsequently to profit or loss:			
Exchange differences on translation of financial statements of overseas subsidiaries		(6,965)	(3,720)
Total comprehensive income for the year		1,974,986	1,924,442

The notes on pages 11 to 92 form part of these financial statements.

Consolidated Statement of Comprehensive Income (Continued)
For the year ended December 31, 2013
(Expressed in Renminbi unless otherwise stated)

	Note	2013 *RMB'000*	2012 *RMB'000*
Profit attributable to:			
Shareholders of the Company		1,959,257	1,927,689
Non-controlling interests		984	473
Profit for the year		1,960,241	1,928,162
Total comprehensive income attributable to:			
Shareholders of the Company		1,974,823	1,925,325
Non-controlling interests		163	(883)
Total comprehensive income for the year		1,974,986	1,924,442
Basic and diluted earnings per share (RMB)	12	0.47	0.58

The notes on pages 11 to 92 form part of these financial statements.

Consolidated Balance Sheet
At December 31, 2013
(Expressed in Renminbi unless otherwise stated)

	Note	2013	2012
		RMB'000	*RMB'000*
Non-current assets			
Property, plant and equipment	14	485,012	444,205
Investment properties	15	14,163	15,711
Lease prepayments	16	1,788,109	1,827,148
Intangible assets	17	7,919	7,659
Interest in associates		215	413
Other non-current assets	19	343,944	253,952
Trade and other receivables	21	53,382	39,050
Construction contracts	22	3,201,943	4,114,329
Deferred tax assets	29(b)	154,577	131,311
Total non-current assets		6,049,264	6,833,778
Current assets			
Inventories	20	212,735	225,731
Trade and other receivables	21	4,894,653	5,510,059
Construction contracts	22	2,372,575	3,191,436
Restricted deposits	23	251,435	447,351
Time deposits with original maturity over three months		3,622,336	6,472,079
Cash and cash equivalents	24	14,550,166	12,089,395
Total current assets		25,903,900	27,936,051
Current liabilities			
Borrowings	25	234,307	133,920
Receipts in advance	26	7,021,664	12,710,410
Trade and other payables	27	12,227,087	10,943,270
Retirement and other supplemental benefit obligation	28(a)	30,870	31,660
Income tax payable	29(a)	276,013	451,258
Total current liabilities		19,789,941	24,270,518
Net current assets		6,113,959	3,665,533
Total assets less current liabilities		12,163,223	10,499,311

The notes on pages 11 to 92 form part of these financial statements.

Consolidated Balance Sheet (Continued)
At December 31, 2013
(Expressed in Renminbi unless otherwise stated)

	Note	2013	2012
		RMB'000	*RMB'000*
Non-current liabilities			
Borrowings	25	79,637	154,618
Trade and other payables	27	1,705	60,956
Retirement and other supplemental benefit obligation	28(a)	325,820	365,540
Deferred tax liabilities	29(b)	-	774
Total non-current liabilities		407,162	581,888
NET ASSETS		11,756,061	9,917,423
CAPITAL AND RESERVES	30		
Share Capital		4,125,700	4,018,000
Reserves		7,613,925	5,902,341
Total equity attributable to the shareholders of the Company		11,739,625	9,920,341
Non-controlling interests		16,436	(2,918)
TOTAL EQUITY		11,756,061	9,917,423

Approved and authorized for issue by the board of directors on March 24, 2014.

Name: Sun Bai
Position: Chairman

Name: Zhang Chun
Position: Director

The notes on pages 11 to 92 form part of these financial statements.

中國機械設備工程股份有限公司
China Machinery Engineering Corporation
House No. 8, Street No. 41, F-7/1, Islamabad.Phone: +92 51 2652553; Fax: +92 51 2652550

Prospectus

Introduction of the Applicant

China Machinery Engineering Corporation (CMEC) is the sponsor who undertakes to carry out the 1x300MW (net) Coal Based Independent Power Generation Project at Pind Dadan Khan in Salt Range, Punjab. The main functions of CMEC include generation of electricity and supply thereof. CMEC is in the process of establishing a Special Purpose Vehicle (SPV) company in Pakistan as an unlisted limited company incorporated under 32 of the Companies Ordinance, 1984. Once this SPV is established, CMEC will novate /assign the generation license as well as the related rights and obligations to this SPV.

Founded in 1978, CMEC is the first large engineering & trade company in China, and a member of China National Machinery Industry Corporation (SINOMACH). It is a conglomerate taking engineering contracting as its core business and investment, integrating trade, R&D, and international service.

Salient features of the facility

Plant Location: Pind Dadan Khan, Salt Range, Punjab
Type of Facility: Coal Fired Thermal Power Pants
Fuel: Indigenous Coal
Proposed Buyer: NTDC
Total Gross Installed Capacity (at Mean Site Conditions): 330MW (TMCR)
Rated Capacity (at Mean Site Conditions): 300MW (TMCR)
Plant Configuration:

Steam Turbine: Tandem compound, single reheat, regenerative, condensing, multi cylinder design with combined HP-IP and separate LP casing(s), directly coupled with generator suitable for indoor installation

Boiler: Direct pulverized coal fired, sub-critical, single drum, and single reheat, radiant, outdoor arrangement, completely hanging construction, balanced draft type.

Generator: The stator winding are water inner-cooled, while the rotor winding is hydrogen inner-cooled and stator core hydrogen cooled.

Life of Facility: 30 years

Proposed investment

Estimated Total Project Cost: US$588.98 Million
Debt (75%): $441.74 Million
Equity (25%): $147.24 Million

The total Project cost is estimated at $588.98 Million which is to be financed based on a 75:25 Debt to Equity Ratio. Equity will be contributed by Project Sponsor CMEC. Debt is proposed to be financed from

various financial institutions, primarily from China. The project is financially feasible in terms of its ability to secure required debt obligation for the loan period.

The Company is already in discussion with various financial institutions for acquiring financing for the project.

Social and Environmental Impact of the Proposed Facility

This project is designed in accordance with the standards and requirements of the World Bank/ International Finance Corporation and National Environmental Quality Standard of Pakistan, to minimize potential pollutions to the local region.

As Pakistan is suffering from acute energy shortages which hinder its economic development and increase the living expenses of the people, the successful implementation of this project will bring more power to the grid and thus help alleviate the power shortages. In addition, CMEC intend to hire skilled workers from the local region during the construction and operation of the power plant, which will help further improve the well being of the local people.

CMEC will remain committed to environmental compliance in its operation and will develop processes and programs to proactively prevent and mitigate possible adverse impacts on the environment. In the meantime, CMEC will remain committed to respect the local cultures and religious beliefs in its operation, and thus to prevent and mitigate possible adverse impacts on the social aspects.

GOVERNMENT OF PAKISTAN
MINISTRY OF WATER & POWER
PRIVATE POWER & INFRASTRUCTURE BOARD

No. 1(103) PPIB-6014/14/PRJ

19th November 2014

Mr. Su Guanglei
Chief Resident Representative
China Machinery Engineering Corporation
House No. 8, Street No. 41
Sector F-7/1, Islamabad

Subject: **LETTER OF INTENT - 300 MW COAL BASED INDEPENDENT POWER GENERATION PROJECT AT PIND DADAN KHAN (SALT RANGE) PUNJAB BY CHINA MACHINERY ENGINEERING CORPORATION**

Dear Sir,

Whereas, the Government of Punjab through Punjab Power Development Board Energy Department has inter-alia conveyed and stated through its letter No. PPDB/1208/2014 dated 19th November 2014 (the "**Letter**"), that China Machinery Engineering Corporation, (hereinafter referred to as ' **the "Sponsor"**) approached the Government of Punjab and has expressed its interest for developing a 300 MW Mine Mouth Indigenous Coal Project at the Pind Dadan Khan / Salt Range Site (the "**Project**");

Whereas, the Letter further states that, the Mines and Minerals Department, Government of Punjab is of the view that the availability of Punjab Coal is sufficient to fuel this Project and that this Project will pave way for about 1500 MW indigenous coal based power projects in Punjab;

Whereas, the Letter concludes that, in light of the above, the Government of Punjab through Punjab Power Development Board supports the said Project and has forwarded it to Federal Government through PPIB for processing under its policy.

Whereas, the Project is included as an Actively Promoted Project under the Agreement on the China-Pakistan Economic Corridor Energy Project Cooperation between the Government of the People's Republic of China and the Government of the Islamic Republic of Pakistan;

50 - Nazimuddin Road, F-7/4, Islamabad - Pakistan
Tel: (92-51) 9100118-29 Fax: (92-51) 9100131, 9100132
Email: ppib@ppib.gov.pk Internet: http://www.ppib.gov.pk

under the Guidelines for obtaining the LOS from PPIB. Provided further in the said events of delay to obtain Tariff Determination or LOS by the Sponsor/ Project Company are solely attributable to the NEPRA or PPIB as the case maybe, then the Sponsor/ Project Company shall be entitled to an extension on an application in writing to PPIB in the term of this LOI commensurate with such period of delay, provided further that the Performance Guarantee shall be extended by the Sponsor for a period not less than three (3) months beyond such extended term of the LOI;

4. If PPIB acting in its sole discretion determines that any delay by the Sponsor / Project Company in obtaining the Tariff Determination is due to events beyond the reasonable control of the Sponsor / Project Company, PPIB shall be entitled acting on an application in writing made to it by the Sponsor / Project Company at least thirty (30) days before the expiry of this LOI, to grant in writing to the Sponsor / Project Company a one-time extension of up to a maximum period of three (3) months beyond the LOI expiry date, provided however, that such an extension in the term of the LOI would only be granted upon submission of the Performance Guarantee (in double the amount) with validity of three (3) months beyond the extended LOI;

5. This LOI shall, be effective from the date hereof and unless terminated or extended earlier pursuant to the terms herein, continue to be in full force and effect until the issuance of LOS or for period of six (06) months, whichever is earlier;

6. The rights and obligations of the parties pursuant to and under this LOI shall be governed by the laws of Pakistan;

7. This LOI shall in no way be construed as an award of the Project as no such vested legal or contractual rights shall accrue, in your favour, till such time, valid Project Agreements (as defined in the LOS) are executed in accordance with the terms and conditions contained therein;

8. Issuance of this LOI or its termination or expiry cannot form the basis of any claim for compensation or damages against the Government of Pakistan, PPIB or any of its agencies on any grounds whatsoever, during or after the expiration or termination by the Sponsor / Project Company; and

9. The obligations and liabilities of the Sponsor and Project Company under the LOI and the Performance Guarantee shall be joint and several.

Kindly sign the attached copy of this LOI at the place indicated and return the same to us no later than seven (07) days.

under the Guidelines for obtaining the LOS from PPIB. Provided further in the said events of delay to obtain Tariff Determination or LOS by the Sponsor/ Project Company are solely attributable to the NEPRA or PPIB as the case maybe, then the Sponsor/ Project Company shall be entitled to an extension on an application in writing to PPIB in the term of this LOI commensurate with such period of delay, provided further that the Performance Guarantee shall be extended by the Sponsor for a period not less than three (3) months beyond such extended term of the LOI;

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Kindly sign the attached copy of this LOI at the place indicated and return the same to us no later than seven (07) days.

For & on behalf of Private Power & Infrastructure Board	For & on behalf of Sponsor
(Shah Jahan Mirza) Managing Director	**(Su Guanglei)** Chief Resident Representative

Cc:

(a) **Chairman**, Private Power & Infrastructure Board, Islamabad

(b) **Chairman,** National Electric Power Regulatory Authority, Islamabad

(c) **Additional Chief Secretary (Energy),** Energy Department, Government of Punjab

(d) **Managing Director,** National Transmission and Despatch Company, Lahore

(e) **Managing Director,** Punjab Power Development Board, Lahore

中国機械設備工程股份有限公司
China Machinery Engineering Corporation
House No. 8, Street No. 41, F-7/1, Islamabad.Phone: +92 51 2652553; Fax: +92 51 2652550

Profile of Applicant & Experiences

China Machinery Engineering Corporation (CMEC) was built on its predecessor China National Machinery & Equipment Import & Export Corporation through an overall reorganization. On December 21st, 2012, CMEC was listed in the Hong Kong Stock Exchange. Founded in 1978, CMEC is the first large engineering & trade company in China, and a member of China National Machinery industry Corporation. It is a conglomerate taking engineering contracting as its core business and integrating trade, R&D, and international service.

After painstaking efforts for more than three decades, CMEC has successfully reshaped its business pattern, and evolved into an internationally reputed and domestically leading engineering contractor mainly engaged in international projects and trade. As a world-renowned engineering contractor, CMEC has been ranked among China's top 10 contractors by the business turnover from overseas contracted projects by the Chinese Ministry of Commerce for many consecutive years.

CMEC has always taken the leadership in the international contracting market, and, in particular, been recognized as "China's First" in a number of international projects. As for its business in the power sector, in the 1980s, CMEC contracted the 210MW Guddu Thermal Power Station Unit 4 under the export seller's credit, the first of its kind in China. With the advent of the new century, CMEC took the lead to introduce the made-in-China 600MW supercritical coal-fired generator set to the international market, which has been connected to the grid for power generation. CMEC has also made outstanding achievements in other sectors, including the building of the first national radio & TV center in Africa.

According to an IPSOS report, CMEC ranked 4th in 2012 among Chinese contractors in terms of revenue from international power and energy projects worldwide. In December 2012, CMEC's EREN 2×600MW Supercritical Coal Fired Power Plant in Turkey won the Luban Prize (overseas project), the highest prize for construction projects of China, making it the first coal fired power plant to win this prize. At the 11th China Congress on Project Management held in November 2012, the Phase I project of Puttalam Power Plant in Sri Lanka was accorded the China Project Management Achievement Award by China Project Management Research Committee.

CMEC has extended its business reach to more than 150 countries and regions in the fields of international engineering contracting and international trade in general. The contracting business involves a broad range of areas such as electric power, transportation, electronic communications, housing & architecture, plant construction, environmental protection, mining and resource exploration.

Now CMEC has 26 affiliates in the Chinese mainland, 13 affiliates in the Hong Kong Special Administrative Region (Hong Kong SAR) and foreign countries, and 26 representative offices overseas. As a key member of the China Chamber of Commerce for Import and Export of Machinery and Electronic Products (CCCME) and the China International Contractors Association (CHINCA), it has won a triple-A credit rating as an international contractor, and the high recognition of government authorities, financial

and insurance institutions and its peers. CMEC has been ISO9001:2008, ISO14001:2004 and OHSAS 18001:2007 certified in terms of quality, environmental, and occupational health and safety management, which ensures the top quality of the products and services it offers.

CMEC embraces the corporate philosophy of "Create Ideas, Achieve Dreams", takes "improving people's quality of life" as its social responsibility, and devotes itself to the promotion of mutual benefit, common development, and harmonious progress. Carrying forward the corporate culture of "people orientation; innovation, competition and cooperation; integrity, devotion and harmony", CMEC is making every effort to build itself into an internationally leading contractor and service provider engaged in international contracting, international trade and related service industries.

CMEC's project references are listing as below

No.	Country	Project Name	Capacity	Scope	Status
1	Pakistan	Guddu TPS Unit 4	1x210MW	Survey, Design, Manufacture, Supply, Installation, Commissioning, Training	1987
2	Pakistan	Jamshoro TPS Units 2, 3 & 4,	3x210MW	EPC turnkey	1991
3	Pakistan	Muzaffargarh TPS Unit 4	1x320MW	EPC turnkey	1997
4	Pakistan	Muzaffargarh TPS Units 5 & 6	3x210MW	EPC turnkey	1996
5	Pakistan	Saif 200MW Combined Cycle Power Plant at Sahiwal	200MW	EPC turnkey	2010
6	Pakistan	Muzaffargarh Gatti 500kV Substations Extension	500KV	EPC turnkey	2008
7	Pakistan	Neelum Jhelum HPP	970MW	EPC turnkey	under construction
8	Malaysia	Mukah Coal-fired Power Plant Project	2x135MW	EPC turnkey	2010
9	Sri Lanka	Puttalam Coal-fired Power Project	1x300MW	EPC turnkey	2010
10	Turkey	IZDEMIR Supercritical Coal-fired Power Plant	1x350MW	EPC turnkey	under construction

For more information, please visit website: www.cmec.com.

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Technical Details

1. Project: 1x300MW (net) Coal-fired Power Project at PindDadan Khan in Salt Range, Punjab.
2. Type of Facility: Subcritical Coal Fired Power Plant
3. Rated Gross Output (at Mean Site Conditions): 330MW (TMCR)
4. Rated Net Output (at Mean Site Conditions): 300MW (TMCR)
5. Net Plant Efficiency (at Mean Site Conditions): 37%
6. Auxiliary Power Consumption Rate: 8%
7. Particulates Emission: ≤50 mg/Mm³ at Inlet of Chimney
8. NOx Emission: ≤510 mg/Mm³ at Inlet of Chimney
9. SO2 Emission: ≤900-1500 mg/Mm³ at Inlet of Chimney
10. Frame Size: 1x3 phase
11. Power Factor: 0.85 (This is the 5-year average value. Allowances shall be granted in the PPA for first year after COD and major maintenance year during operation).
12. Terminal Voltage: 20kV
13. Frequency/Speed: 50Hz/ 3000 rev/min

For more details, please refer to Feasibility Study Report.

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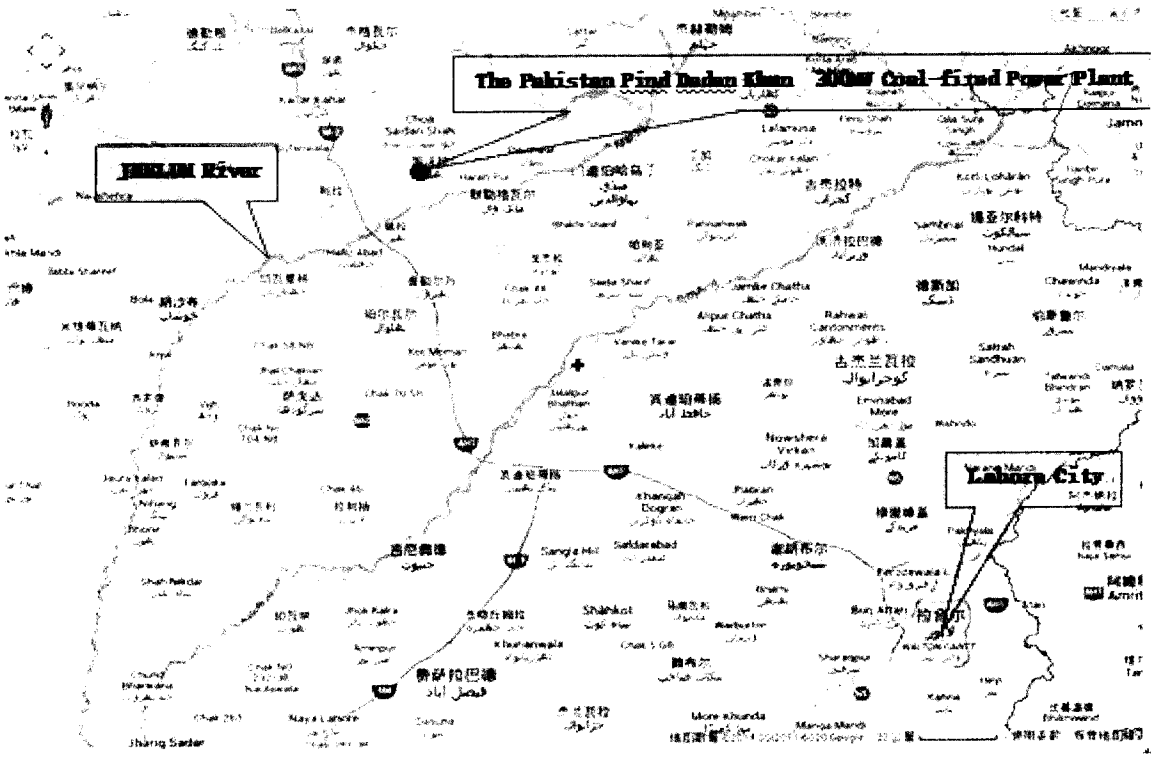
Schedule III

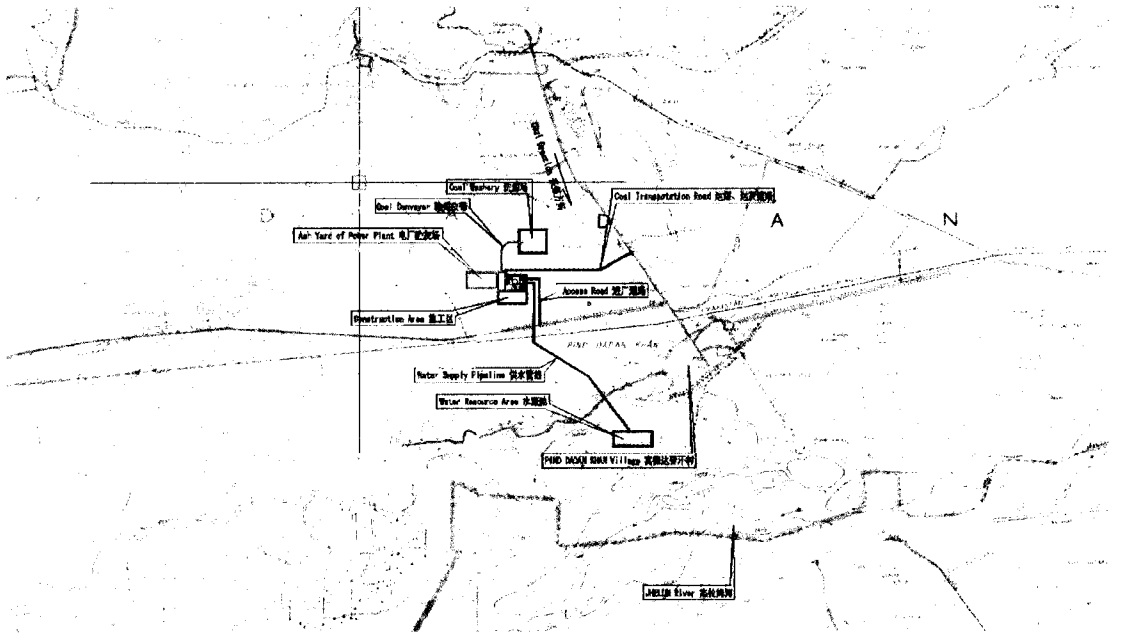
1. Location maps, site map, land

The 1x300MW (net) Coal-fired Power Plant locates northwest about 2km to PindDadan Khan town, KallarKahar, Salt Range,Punjab, near the intersection of two main roads. The site lies north about 4km to JHELUM River. The terrain of site slopes gently and the site elevation is about 210m. The approximate coordinate of site is Latitude: 32°36'3.08", Longitude: 73°0'21.43" (The coordinate can be adjusted according to advice of government). The site is about 170km (straight line distance) away from Lahore city.

Location Map and Overall Planning Map shows as below:



Picture1: Site location



Picture2: Overall planning of power plant

2. Technology, size of the plant, number of units

One coal fired boiler and accessories, one condensing steam type turbine-generator sets and accessories shall be included. The stream turbine gross output in TMCR condition shall be 330MW at mean site conditions.

3. Fuel: type, imported/indigenous, supplier, logistics, pipeline etc.

The boiler shall be PC type which shall designed to burn indigenouscoal as main fuel.

The coal shall be transport from Coal-Washing Plant through conveyor belt or trucks. The Coal-Washing Plant shall be near to the power plant with a distance of 1000m. In addition, coal shall be supplied from coal mines nearby by trucks.

4. Emission values

The project will conform to the environmental protection laws, regulations, and standards of Pakistan and World Bank/IFC standards of environmental protection.

Since the overall standards of World Bank/IFC Standards are higher than the local environmental standards in Pakistan, the prospective emission values listed below are according to World Bank/IFC standards.

4.1 Atmospheric Emission Limit Values

Substance	Unit	Emission Limit Values
SO_2	mg/Nm^3	900-1500
NOx	mg/Nm^3	510
Particulate Matter (PM)	mg/Nm^3	50

Remark: Emission concentration is corrected as 6% O_2 on dry flue gas.

4.2 Effluents Discharge limits for treated effluent quality

Parameter	Unit	Limits
pH	/	6-9
BOD	mg/L	30
COD	mg/L	125
Total Nitrogen	mg/L	10
Total Phosphorus	mg/L	2
Grease and oil	mg/L	10
TSS	mg/L	50
Total residual chlorine	mg/L	0.2

4.3 Noise

The noise emitted from the Projectwill not exceed the following values:

- The noise level of equipment (at 1 m from the equipment): ≤85 dB(A);
- The noise level in Control Room: ≤60 dB(A).

Noise impacts for the Project will not exceed the levels presented in the following table, or result in a maximum increase in background levels of 3 dB(A) at the nearest receptor location off-site.

Receptor	Daytime(07:00-22:00)	Nighttime(22:00-07:00)
Residential; institutional; educational	55 dB(A)	45 dB(A)
Industrial; commercial	70 dB(A)	70 B(A)

5. Cooling water source: tube wells, sea/river/canal, distance from source, Etc.

Groundwater shall be used as water source and providedto power plant by piping. The necessary wellsshall be drilled near JHELUM River. The distance from power plant to the water source is about 5km.

6. Interconnection with national grid company, distance and name of nearest grid, voltage level (single line diagram)

The proposed interconnection scheme for the 300MW (net output) Coal Fired Power Plant to the National Grid is given as under according to the Interconnection Study (Report-1) conducted by NTDC.

- A 132kV Double Circuit (D/C) transmission line, approx. 35km long on Rail conductor, from the power plant to C.S. Shah.
- A 132kV D/C transmission line, approx. 35km long on Rail conductor, from the power plant to Head Faqirian.
- A 132kV Single Circuit (S/C) transmission line, approx. 10km long on Rail conductor, from the power plant to Dandot.

The single line diagram for power plant will be provided later by NTDC.

7. Infrastructure: roads, rail, staff colony, amenities

7.1 Roads

(1)Access Road

The access road will connect to the existing road at south of power plant and enter from east. The access road shall be 7m wide reinforced concrete pavement, about 1100m long.

(2) Coal Transportation Road

The coal transportation road will connect to the existing road at east of power plant and enter from north. The coal transportation road shall be 7m wide reinforced concrete pavement, about 3km long.

(3) Ash and Slag Transportation Road

The ash and slag transportation road will be driven to the ash yard which shall be located near to the power plant. The road shall be 7m wide reinforced concrete pavement, about 100m long.

7.2 Rail

No rail connection.

7.3 Staff colony and Amenities

There will be around 500 people staying at the project site during peak construction time and during operation. A living colony will be constructed at southeast of power plant, and near the access road, about 7.5ha. Total area of living area for the staff colony is about 20,000 ㎡. The buildings are foreseen as a concrete or brick building.

Amenities will be provided, which include

- One clinic with not less than 3-5 doctors and nurses;
- Sports center;
- Dining room & convenience store.

8. Project cost, information regarding sources and amounts of equity and Debt

Total project cost will be $588.98 million, among which equity and debt ratio is 25%:75%. The project financing will be primarily sourced from Chinese Banks.

9. Project commencement and completion schedule with milestones

The Project is expected to be completed within 40 months after the Financial Close, which is in line with the requirements specified by NEPRA for plants of this capacity. if assumed the financial closeis achieved by October 2015, CODof the unit shall be in March 2019. The preliminary plan for this project is shown as below:

Date	Target	Remark
Nov 19, 2014	LOI issued by PPIB	Already issued
Jan 22, 2015	Submission of Tariff Petition & Generation License to NEPRA	
Mar 25, 2015	The EPC technical specification complete, which could mobilize the EPC bidding.	
Apr 25, 2015	Determination of EPC Contractor	
May 30, 2015	Tariff approval and issuance of Generation License	
Jun 30, 2015	LOS	
July 30 2015	Signing PPA/IA	
Oct 30, 2015	Financial Close	
Nov 5, 2015	Commencement of Project	
Mar 5. 2016	Start of Site preparation and Piling works	
Sep 5. 2016	Excavation of main power house foundation	
Jan 5. 2017	Start erection for boiler steel structure	
Sep 5.2017	Steam turbine plate locating	
May 5. 2018	Power receiving	
Jul 5. 2018	Turbine Covering and Boiler hydraulic test finished	
Dec 5. 2018	Whole start-up and commissioning	
Feb 5. 2019	Running test	
Mar 5, 2019	COD	

10. ESSA (Environmental and Social Soundness Assessment)

The development of Coal-fired Power Project will reduce dependence on gaseous and liquid fuels for thermal power generation and increase diversity in Pakistan's electricity generation mix.

CMEC has carried out a detailed Environmental Impact Assessment Study ("EIA Study") through Engineering Consultancy Services Punjab (ECSP) Pvt. Ltd in accordance with the standards and requirements of the World Bank/International Finance Corporation and National Environmental Quality Standards.

The EIA refers to an Environmental Management Plan ("EMP") prepared for effective implementation and management of mitigation measures, wherein a delivery mechanism is provided to address potential impacts of project activities, to enhance project benefits and to introduce standards of good practice in all project activities. The EMP has been prepared with the following objectives:

- Defining legislative requirement, guidelines and best industry practices & standards that apply to the project;
- Defining monitoring/ mitigation plan required for avoiding or minimizing potential impacts;
- Defining roles and responsibilities f the project proponent and the contractor;
- Defining requirements for environmental monitoring and reporting;
- Defining the mechanism with which training will be provided to the project personnel.

The project entails construction of new coal-based boiler and steam turbine generator (STG). This will have positive impacts on the socio-economic environment through direct and in-direct employment generation and increased business opportunities.

The main fuel for the project is coal. The possibility of using both imported and local coal and its impact are also assessed. Limestone will be supplied by local market and will be used as sorbent to capture the SO_2 in the Flue Gas Desulphurization (FGD). The project emissions shall comply with the local NEQS standards and World Bank guide lines.

Environmental sensitivities and impacts, as well as the associated mitigation plan have been addressed in the EMP/EIA study. Further, CMEC will ensure that the project staff will be adequately trained in Health, Safety and Environment sensitivities and operational management procedures, so that all levels of staff effectively contribute to impact prevention and mitigation at all times.

The project is expected to generate significant local job opportunities both during the construction phase and operation phase which will be filled by Pakistani nationals. It is also expected that part of the available unskilled jobs will be provided to the locals belonging to the vicinity of project area (as the latter do not have the required education or skill for the skilled or semi-skilled jobs for the project).

11. Safety plans, emergency plans

CMEC operates in all parts of its organizational functionalities keeping safety as its top priority. Therefore the project will adopt relevant guidelines to ensure safety of men and material deployed at plant site. CMEC will strive to ensure that the community works in a healthy, safe and environmental friendly atmosphere. For the reason the company has designed its values and behaviors amongst which Health, Safety and Environment (HSE) is of utmost importance and priority. CMEC is committed to building a safe and healthy workforce that contributes towards the business growth and sustainability. It has a proactive approach to achieve zero harm and making endeavors to align itself with internationally recognized Safety Management Systems.

CMEC not only has a tradition of safety at work, but strongly encourages its employees to carry this mindset beyond the workplace and into their homes and communities. Thus CMEC will ensure safety of all working personals as well as the equipment by incorporating the most stringent safety laws and practices in its working boundaries. CMEC will ensure that all the work practices are will within a healthy, safe and environmental friendly atmosphere, by giving utmost importance and priority to the key factors and guidelines promoting safety and health.

12. System studies: load flow, short circuit, stability, reliability

Interconnection Study for Evacuation of Power from 300W Coal-fired Power Plant at PindDadan Khan to the National Grid had been conducted and finalized by National Transmission and Despatch Company Limited (NTDC):

On the basis of the detailed load flow analysis, the following interconnection scheme has been proposed for reliable dispersal of power from 300MW CMEC Power Plant to the National Grid System under normal and single line contingency conditions:

- A 132 kV D/C transmission line, approx. 35 km long on Rail conductorfrom CMEC Power Plant to C.S Shah.
- A 132 kV D/C transmission line, approx.35 km long on Rail conductor from CMEC Power Plant to Head Faqirian.

- A 132 Kv S/C transmission line, approx. 10 km long on Rail conductor from CMEC Power Plant to Dandot.

Detailed plant data to conduct short circuit and transient stability studies are currently under review by NTDC.

13. Plant characteristics: generation voltage, frequency, power factor, Automatic generation control, ramping rate, alternative fuel, auxiliary Consumption, time(s) required to synchronize to grid

- Generation voltage: the outgoing voltage is 132kV, and the generator shall be connected to 220kV substation.
- Frequency: 50Hz
- Power Factor: 0.85
- Alternative Fuel: the boiler plant shall be designed to burn local coal as main fuel, and the LDO shall be used as the ignition and assistant fuel.
- Auxiliary Power Consumption: 8% based on TMCR condition (the maximum continuous rating of generator is 330MW at mean site conditions)

14. Control, metering, instrumentation and protection

The I&C system is designed to ensure safe, reliable, available economic and simple operation and easy coordination to different operation requirements.

Thel&C system is designed to accomplish the operation of boiler, turbine, generator and auxiliaries and BOP system from the operator station in the control room. The instrumentation and controls normally relive the operator from continual regulation duties and are backed up by interlocks or safety systems which case preplanned action to prevent unsafe situation developing.

The I&C system used state of the art technology and hardware. The equipment is designed to meet the vital need for safeguarding the plant, controlling the required output reliably and enabling the station to operate efficiently.

For more detail, please review Paragraph 5.12 of Feasibility Study Report.

15. Training and development

As per the multi-package contract (s) it will be the OEMs responsibility to provide customized operation and maintenance training to employer's personnel. Such trainings include class room as

well as On Job Training (OJT). During commissioning and start-up period, vendor specific training will be provided on-site to the employer's personnel for specified specialist skill for the operation and maintenance of the plant machinery and equipment.

For sustainable optimized performance, CMEC strongly believes in allocating budget for the training and development of the employees on an ongoing basis. Moreover, CMEC has its own technical training centers and a Training Need Analysis (TNA) based program which determines the training needs and provides training to its employees. The program has cross-functional trainings for the availability of multi skilled people. In order to upgrade the technical capabilities, different certification programs will be offered to CMEC employees.

16. Feasibility report

Feasibility study report is as attached.

1x300MW Coal-fired Independent Power Generating Project

at

Pind Dadan Khan (Salt Range), Punjab, Pakistan

FEASIBILITY STUDY REPORT

CHINA MACHINERY ENGINEERING CORPORATION

January 2015

1 GENERAL

1.1 PROJECT DESCRIPTION AND GENERAL REQUIREMENTS

1.1.1 Project Description

China Machinery Engineering Corporation (hereafter as CMEC), as the Sponsor intends to build 1x300MW (net) coal based independent power generation plant at Pind Dadan Khan in Kallar Kahar Region/Salt Range in Punjab, Pakistan (hereinafter referred to as the "Project").

The Project includes one PC type coal fired boiler and accessories, one condensing steam type subcritical turbine-generator sets and accessories. The boiler shall be designed to burn local coal as main fuel, and the LDO shall be used as the ignition and assistant fuel. The mechanical systems, coal handling system, water supply system, water treatment system, DM water system, cooling water system, electrical system, I&C, fire fighting, waste water treatment plant, ash handling system, HVAC system etc. shall be included. This Project will be built in BOO/BOT mode.

The feasibility study of the project shall be developed at one potential project site named Pind Dadan Khan which was identified in the Letter of Intent (LOI) issued by Private Power and Infrastructure Board (PPIB).

1.1.2 Significance of Coal Fired Power Plant

Pakistan has been experiencing power shortage that causing tremendous adverse impact on the economy and inconvenience to the general public, estimated average load growth rates in year 2015-2020 is expected 7.65% based on yearly average, summary of the load forecast in year 2015-16 to 2019-20 is about to reach 37,592 to 50,495MW, total installed capacity of electric power generation system is 22,549 MW in 2010, that huge gap between power demand and supply is obvious.

In order to alleviate energy crisis, Government of Pakistan has made power policies to attract and encourage investment in power generation from Independent Power Producers (IPPs), which emphasize the use of indigenous fuel resource to keep electricity prices within affordable limits for consumers.

On the other hand, the Government of the Punjab plans to use its coal resources to cope with the acute energy shortage in the Province by installing coal-fired power plants. Currently coal mining activities are concentrated in the Eastern and Central portion of the Salt Range and Makerwal area of Trans Indus Range. The anticipated coal deposits of the Punjab estimated at 235 million tons in 1984-88 are re-authenticated (in 2010-12) by SNOWDEN, an Australian Consulting firm using "Mineral Resources and Ore Reserves, 2004 ("The JORC Code, 2004") and the Australian Guidelines for Estimating and Reporting of Inventory Coal, Coal Resources and Coal Reserves, 2003 Edition ("The Coal Guidelines"). As a conclusion, Coal Resource Estimates in Salt Range is 443.62 Mt.

SNOWDEN has developed a Resource Estimate for the various zones within the Salt range and inventory coal estimates for Trans Indus Range (Makerwal) and Jhelum (Jogi Tilla). Ash fusion tests of the coal indicate that in all likelihood there shall be no problem with this coal for utilization in power generation.

As above mentioned conditions, CMEC intends to build 1x300MW coal based thermal subcritical power plants in Salt Range coal mine area in Punjab.

1.1.3 General Requirements

Considering the requirements for the project, their arrangement and structural design, the following main principles shall be taken into consideration and all the works of Power Plant shall be implemented to provide in particular for:

- Safety of the personnel and the equipment,
- Conformity with the standards, codes and instructions,
- High reliability and availability of the equipment,
- Designing in accordance with the most modern practice,
- Using brand-new, quality materials and equipment, unused for any reason except for testing purposes,
- Using no prototype,
- Interchangeability of the equipment,
- Eliminating any type of corrosion and electrical ionization effects between different parts of the materials, taking adequate precautions, having an emergency system,
- Conformity with the approved test schedule,
- Continuity and ease in plant operation,
- Power generating economy,
- Minimum maintenance cost,
- Minimum wastewater discharge by utilization of wastewater.

1.2 SCOPE OF WORK AND TERMINAL POINTS

1.2.1 Scope of Work

The scope of this project shall be whole power plant and auxiliaries, comprising the make-up water supply and ash storage yard which including engineering, construction, manufacturing, testing, commissioning, delivering all goods, equipment and materials, civil works, erection, commissioning and reliability test as well as the technical services/advices and documentation for normal operation and maintenance, providing safe, reliable, efficient, economic and reliable operation, and plant maintenance.

Power transmission lines shall not be excluded.

The scope of this proposal is to construct net output 1×300MW subcritical Coal-fired thermal power unit with common facilities, the capacity of common facilities only considers for one (1) unit. The plant shall have the following major units:

- One (1) subcritical Steam Generating Units each with a net output of 300MW, firing coal as main fuel.
- One (1) Condensing subcritical steam turbines and condenser.
- Water cooling systems in adequate capacity.
- One (1) AC generator with fully static excitation system.
- Unit step-up transformer and unit auxiliary transformer,
- Complete systems of electrical and mechanical control and monitoring equipment.
- Power house buildings equipped with appropriate, ventilation and air conditioning systems.
- Central control building to all the control and monitoring systems of the power plant.
- Coal and ash handling system, including the coal yard.
- Limestone system with the Limestone storage, handling system.
- Service / seal air and process water distribution system.
- All necessary auxiliary plant as specified in this Proposal.

1.2.2 Terminal Points

The CMEC's principle work scope shall be within the boundary of plant. The terminal points listed as following.

No.	Description	Terminal Point
1	Fuel System	
a)	LDO unloading system	At LDO road tanker outlet. Quick couplings shall be in the scope of Contractor
b)	Coal transport	From and excluding coal beneficiation plant.
2	Outgoing connection of high voltage	At the gantry of 132kV outgoing line
3	RTU system	At the terminals of RTU system in switchyard control room
4	Metering system	At the terminals of metering system in switchyard control room
5	Communication system	At the terminals of PLC cabinet in switchyard control room
6	Telephone system	At the terminals of PABX cabinet of power plant.

1.3 CODES AND STANDARDS

Chinese code will be used in the project except the mandatory code of Pakistan.

The Design shall be in accordance with the following Chinese standards:

- Technical code for design of thermal power plant air & flue gas ducts/pulverized coal piping（DL/T 5121-2000）
- Technical code for explosion prevention design of coal and pulverized coal preparation system of fossil fuel power plant （DL/T 5203-2005）
- Code for design of thermal insulation and painting of fossil fuel power plant （DL/T 5072-2007）
- Code for Oil/Gas Piping Design of Fossil fuel power plant（DL/T 5204-2005）
- Code for hydraulic design of fossil fuel power plants （DL/T 5339-2006）
- Code for flow duct designing and arranging of circulating water pump house in fossil fuel power plant（DLGJ150-1999）
- Design code for pumping station（GB 50265-2010）
- Code for design of industrial recirculating cooling water treatment（GB 50050-2007）
- Design code for industrial metallic piping（GB 50316-2000）
- Code for design of outdoor water supply engineering（GB 50013-2006）
- Code for design of outdoor wastewater engineering（GB 50014-2006）
- Code for design of building water supply and drainage（GB50015-2003）

The fire fighting system design shall be complied with NFPA.

1.4 KEY PARAMETERS

The operation time of the unit is 30 years, in the 30 year, the minimum performance of the unit in the whole life shall be followed as below, and these parameters are preliminary and shall be modified in the detail design.

NO	DESIGNATION	UNIT	FIGURES	REMARK
1	Rated Gross Output	MW	330	TMCR condition, 0% makes up water.
2	Rated Net Output	MW	303.6	Summer Conditions，in this condition means Wh en Dry bulb temperature is 31.8℃
3	Steam Turbine Heat Rate	kJ/kW.h	8277	
4	Boiler Efficiency	%	~92.5%	LHV condition, Guarantee coal
5	Auxiliary Power Consumption Rate	%	8%	TMCR condition (the

NO	DESIGNATION	UNIT	FIGURES	REMARK
				maximum continuous rating of generator is 330MW)
6	Unit Gross Thermal Efficiency	%	~39.83%	
7	Unit Net Thermal Efficiency	%	~37%	
8	Unit Net Heat Rate	kJ/Kw.h	~9730	
9	Particulates Emission	mg/Nm^3	≤50	At Inlet of Chimney (O_2=6%, Dry flue gas)
10	Nox Emission	mg/Nm^3	≤510	At Inlet of Chimney (O_2=6%, Dry flue gas)
11	SO_2 Emission	mg/Nm^3	≤900~1500	At Inlet of Chimney (O_2=6%, Dry flue gas)
12	Gross Standard Coal Consumption Rate (standard coal)	g/ Kw.h	~308.8	
13	Net Standard Coal Consumption Rate (standard coal)	g/ Kw.h	~332.4	
14	Water Consumption Rate	$m^3/s.GW$	0.67	The requirement from GB50660-2001shall be less than 0.80
15	Annual availability of Power Plant	%	85	Average value in five years. Allowances shall be granted in the PPA for first year after COD and major maintenance year during operation.

1.5 Assumed condition

No.	Key Words	Information/Document Available or further required	Design Assumption	Description
1	Net connection		The net connection between power plant and local net shall be one level 132kV, five (5) lines; The short current shall be less than 40kA.	The parameters of step-up transformer and switchyard equipments shall be selected according to the assumption
2	Coal particle size		Coal particle size≤30mm	Coal shall be crushed to less than 30mm in size in the power plant via screening and crushing facilities.
3	Limestone particle size		Limestone particle size≤20mm	Limestone will be handling to limestone bin directly without crushing.
4	Coal and ash analysis	Some sample has been taken back to China and tested for some Index, such as calorific value, sulfur content, ash content, moisture, However for sake of accuracy of testing, more quantity of coal need to be sampled in forthcoming stage, which is expected to finish at the end of February.		The influence of coal pulverizing system and flue gas system, which comprises fan, mill, ESP, flue thickness, powder feeding pipe thickness, high and low sulfur content can influence selection of desulfurization system
5	Coal and ash analysis	The data of coal quality, ash analysis, ash fly ash resistivity are being further tested.		Volatile score affecting NOx emission limit values required by the boiler, boiler factory judgment even set low NOx burners, whether it can meet the emission of NOx
6	Limestone data	To be provided after more detailed test on limestone is completed	Assume that the limestone purity is above 90%, the particle size of lime stone is not more than 20mm.	Effect on the desulfurization system and pulping system
7	Oil data	To be provided after more detailed tests on oil is completed	Light diesel oil is assumed. Truck move.	According to the actual situation to determine the final oil system scheme
8	Coal quality data	same as 4		The quantity of ash, the output of ash handling equipment and system, and other professional calculation will be impacted.

9	The raw water analysis		The assumed water data refers to section 5.9.1	The boiler make-up water treatment system of temporary is used: sand filter + reverse osmosis + primary demineralization + mixed bed; Raw water is used for the circulating water treatment system; Circulating cooling water treatment system is assumed temporarily: add sulfuric acid, adding stabilizer, sodium hypochlorite electrolytic salt system;
10	EIA	The Data indicated herein are the requirements quoted in the EIA draft reports conducted by the local consultant, Engineering Consultancy Services Punjab (ECSP) Pvt. Ltd.	SO_2: 900-1500 mg/Nm^3 NOx: ≤510 mg/Nm^3 PM: ≤50 mg/Nm^3 pH: 6-9 BOD: ≤30 mg/L COD: ≤125 mg/L Total Nitrogen: ≤10 mg/L Total Phosphorus: ≤2 mg/L Grease and oil: ≤10 mg/L TSS: ≤50 mg/L Total residual chlorine: ≤0.2 mg/L Noise level of equipment(at 1m from equipment): ≤85 dB(A) Noise level in Control room: ≤60 dB(A) Noise impacts for the Project will not exceed the following levels, or result in a maximum increase in background levels of 3dB(A) at the nearest receptor location off-site: Industrial, commercial: Daytime ≤70 dB(A), Nighttime ≤70 dB(A) Residential; institutional; educational: Daytime≤55dB(A), Nighttime≤45 dB(A)	
11	Flood control measures of power plant site		lacking of flooding information, the flooding prevention for the power plant site shall not considered and the cost shall not be included also in this stage.	The detail flood protection measure shall be confirmed according to the hydrological data in the next stage.

12	Feature and Base Treatment of Hydraulic Structures		seismic precautionary criterion assumed to be 7 degree and the design basic acceleration of ground motion shall be assumed to be 0.1g	natural foundation shall be temporarily considered for deep box foundation, piles foundation shall be temporarily considered for shallow foundation and important buildings in this stage
13	Ash Yard storage and location		It is proposed that the capacity of ash yard meet the requirement for 5 year's ash and slag storage.	The flat ash yard will be set up adjacent to the coal yard of power plant.
14	Water Source		*1)* Ground water lifted by deep well pumps from JHELUM River northern shore will be used as water source for this project. Each deep well pump water flow/ discharge head and quantities is be assumed at first. *2)* Detail ground water quality is be assumed at first, the quality reference Appendix I(water analysis).The water treatment process will be adjusted according to the final well water quality analysis. *3)* The deep well pumps location is not confirmed later, the Pipeline distance is be assumed at first. When deep well pumps location is confirmed later, the Pipeline distance shall be revised.	*1)* Each deep well pump design flow shall be assumed as 150~200m^3/h, and each deep well pump total discharge head shall be assumed as 100m. *2)* According the water quality analysis at present, the well water shall be used for service water, chemical water, cooling tower make-up water, fire-fighting water directly. *3)* The makeup water distance about 5km along with the pipeline.
15	Plant outside drainage system		When Plant Drainage Point is not confirmed, the Drainage Pipeline distance is be assumed at first. when Plant Drainage Point location be confirmed later, the Pipeline distance will revised.	The Cooling tower blowdown water will be reused to Ash Handle system and Coal Handle system, affluent will be discharged to JHELUM river Southern about 6km.
16	Cooling tower		The final cooling tower spray area will be confirmed according to latest meteorological parameter.	A Natural Draft Cooling Tower will be adopted in CW system. Total cooling tower spray area is about 6000m^2. The tower outlet water temperature not more than 32℃ under above meteorological parameter, the final cooling tower spray area will be confirmed according to latest meteorological parameter.

2.0 POWER GRID

2.1 STATUS OF POWER SYSTEM

2.1.1 Capacity of Power System

Total installed power generation capacity in Pakistan in the year 1947 was only 70 MW including Hydel & Thermal generation. The generation capacity existing in the system now called PEPCO (Pakistan Electric Power Company) was 60 MW whereas 10 MW was exist in the system at Karachi now called KESC (Karachi Electric Supply Corporation).

Till June 2010, the generation capacity of Pakistan has grown up to 22,263MW. The population in the country has also grown from 35 to 160 million. Pakistan with a population of approx 160 million is the most densely populated country in the world. Approximately 40% population of the country is still without power. Over three hundred thousand applications for supply of industrial, commercial and domestic connections are pending with the utilities. About 30% villages in the country have still to be electrified. Electricity being the most important component of infrastructure plays a key role in the national development. Per capita consumption of electricity in the country is less than 1,000kWh while in the countries like Malaysia and Indonesia the per capita power consumption is in excess of 20,000kWh. These facts clearly indicate that Pakistan has a long way to go to achieve the level of fast developing and developed countries. Due to extensive growth in the demand of electricity, GOP (government of Pakistan) in order to meet this challenge is encouraging direct investment in the power sector and in particular encouraging the existing IPPs to enhance their generation capacity.

The Pakistan Water & Power Development Authority (WAPDA) and Pakistan Electric Power Company (PEPCO), as Government owned statutory entities, are responsible for electricity supply in Pakistan except Karachi. KESC caters the power needs of the Karachi city and its environs while WAPDA/PEPCO cater the power needs of the rest of the country and account for about 80 percent of the electricity sales in the country.

Out of total installed power generating capacity of Pakistan i.e. 22,263MW, 18,892MW are shared by WAPDA/PEPCO & IPPS and 3,371MW are provided by KESC network, including Karachi Nuclear Power Plant and IPP's located in KESC license area. {Ref: Electricity marketing data, Planning Power Department (NTDC) WAPDA}.

WAPDA / PEPCO is responsible for handling 18,892MW of electricity out of which 11,709MW is the installed capacity of WAPDA/PEPCO and 7,183MW are provided by IPPs (Thermal & Hydel) including 325MW by Chashma Nuclear Power Plant and 286MW of two Rental Gas Turbine Power Stations. Hydel Generation Capacity of 6,555MW represents about 36% of WAPDA system. KESC system manages 2,603MW out of which installed capacity of 1,955MW is owned by KESC whereas IPPs provide 1,279MW and 137MW is the installed capacity of Karachi Nuclear Power Plant.

WAPDA and KESC are interconnected by power transmission lines at 500kV, 220kV and 132kV having a total power transfer capability of about 850MW.

2.1.2 Power sector framework and restructuring

The Government of Pakistan through its Ministry of Water and Power initiated the process of power sector reforms and restructuring in the early 1990s on the advice of the World Bank. The power sector restructuring and reform process, developed in various stages and through different initiatives, is reflected today in various policies, such as the Power Policy 1994, Hydel Policy 1995, Transmission Line Policy 1995, Power Policy 1998, and Power Policy 2002. These policies were developed, to a large extent, to attract private sector participation in a newly restructured power sector. In addition, the NEPRA Act was promulgated to provide the overall regulatory umbrella for the power sector.

Significant reforms were carried out with the aim of breaking WAPDA's Power Wing into multiple discreet and independent generation, and distribution corporatized units, and by placing WAPDA's transmission assets into a single corporatized entity, the National Transmission and Dispatch Company Limited (NTDC). NTDC will assume the additional function of acting as the single-buyer of wholesale generation from multiple generation companies in the market (excluding KESC) for onward transmission and sale to multiple distribution entities.

2.1.3 Structure of the Power Sector

Pakistan has two vertically integrated public sector power utilities, Water and Power Development Authority (WAPDA) and the Karachi Electric Supply Corporation (KESC). WAPDA supplies power to all of Pakistan, except the metropolitan city of Karachi, which is supplied by KESC. The system of WAPDA and KESC are interconnected through 132kV and 220kV double circuit transmission lines. Out of a total generation capacity of about 22,263MW in the country, 11,709MW is owned by WAPDA/PEPCO including 286MW Rental Power, 325MW by the Chashma Nuclear Power Plant (owned by PAEC), 7,183MW by Independent Power Producers (IPPs).and 3,371MW by KESC including IPP's and KANUPP.

1. Pakistan Water & Power Development Authority.

WAPDA was established in 1958 and entrusted with a massive agenda which included generation, transmission and distribution of power along with irrigation, water supply, drainage, flood control, etc. It owns about 50.62 percent of the country's total power generation capacity, serves 88 percent of all electricity customers in Pakistan and has been, until of late, the principal power generation, transmission and supply system in the country. It has a customer's base of over 20 million.

WAPDA's distribution network has been divided into nine electric supply companies, which are successors of former Area Electricity Boards (AEB's). The AEBs were departments within WAPDA to

administer the supply and distribution, construction, expansion, maintenance and operation of the distribution system. The newly incorporated electric supply companies have been structured in line with modern management practices. WAPDA's thermal power generation facilities have been restructured and incorporated to form four generation companies (GENCOs). In addition, a National Transmission & Dispatch Company (NTDC) has been incorporated to perform transmission and dispatch functions.

2. Karachi Electric Supply Corporation.

KESC was incorporated in 1913 and is responsible for the generation, transmission and distribution of electricity in Karachi and its adjoining areas. It has a customer base of 2 million predominantly urban consumers.

Privatization of KESC has been accomplished through sale of its equity interest to a strategic buyer who has been given control over its management.

3. Regulatory Environment.

In order to promote fair competition in the electricity industry and to protect the right of consumers as well as producers and sellers of electricity, the GOP has enacted the Regulation of Generation, Transmission and Distribution of Electric Power Regulation Act, 1997 (NEPRA Act). Under the Act, the National Electric Power Regulatory Authority (NEPRA), has been established for regulation of electric power generation, transmission and distribution in Pakistan. In performing its functions under this Act, NEPRA shall, as far as practicable, protect the interests of the consumers and companies providing electric power services.

2.2 EXISTING FACILITIES OF WAPDA/PEPCO

WAPDA/PEPCO is currently handling a generation capacity of 18,022MW consisting of 11,147MW Thermal and 6,555MW Hydel and 325MW Nuclear owned by Atomic Energy Commission.

WAPDA's primary power transmission is carried out at 500kV and 220kV. Currently WAPDA's 500kV transmission system has about 5,078km of transmission lines and serves about 8,724 MVA of Grid substation capacities. The 220kV transmission systems which supplements the 500kV systems has about 7,325km of transmission lines and serves about 8,996MVA of grid substation capacity.

Secondary power transmission is carried out at 132kV and at 66kV. Secondary transmission lines, 37,616km, are serving about 21,242MVA of grid substation capacity. Primary power distribution is carried out at 33kV and 11kV through about 196,139km circuits of distribution lines. The low voltage secondary power distribution system based on a 4-wire, 3-phase, and 400V systems consist of about 133,771km of distribution lines.

There are 14 newly corporatized entities which were created as a result of unbundling of WAPDA. In addition to the National Transmission and Dispatch Company Limited (NTDC), nine distribution companies and four thermal generating companies have been established, while hydroelectric generating assets has been retained by WAPDA.

NTDC was incorporated in November 1998 and commenced commercial operation in March 1999. It was organized to take over all the properties, rights, assets, obligations, and liabilities of the 220kV and 500kV grid station and transmission lines network owned by WAPDA. NTDC has been entrusted three specific functions: (i) the transmission operations of the high voltage power network (220kV and 500kV voltage), normally referred to as the wire business; (ii) the dispatch of all power generation linked to the national grid; and (iii) the single purchaser/seller of power between power generators, including independent power producers (IPPs) and distributors, with the notable exception of the Karachi Electric Supply Corporation (KESC), which conducts its own purchase and distribution functions within its franchise area but is also able, as a distributor, to purchase from NTDC.

2.3 LOAD GROWTH RATE

In Pakistan, there is an increasing trend in the growth of electric power demand due to growing economy and fast improving living standard. The electric power demand average annual growth rate since 1960 has been 10.65% for energy generation and 10.66% in Power Demand.

The growth rate of 8.30% was estimated for the years 2005 to 2010. The growth rate of 9.45 % has been envisaged up-to the year 2010-15 and the growth rate for the period of 20 years i.e. 2005 to 2025 is estimated to be 8.54% as detailed below:

Table 2.3-1 ESTIMATED AVERAGE LOAD GROWTH RATES (5 YEARS BASIS)

Year	WAPDA	KESC	WAPDA+KESC (Without-Captive)	Captive	Country
2005-10	7.89%	7.89%	7.89%	13.00%	8.30%
2010-15	9.08%	9.65%	9.16%	12.21%	9.45%
2015-20	7.25%	7.87%	7.34%	10.22%	7.65%
2020-25	8.29%	9.09%	8.35%	11.86%	8.79%
2005-25 (Average)	8.13%	8.62%	8.20%	11.82%	8.54%

Considering the past trend and anticipated future developments in the country, WAPDA, in collaboration with the Planning and Development Division of the Energy Wing of the Government of Pakistan (GOP), has prepared and projected in April 2004, three growth rate scenarios (Low, Medium and High) of long term electricity demand from the year 2003 to the year 2025 in the country. The

Regression Based Load forecast taking into account the impact of electricity price changes, has been projected for 22 years i.e. from the year 2003-04 to the year 2024-25 as shown in Table 2.3-2

Table 2.3-2 SUMMARY OF REGRESSION BASE LOAD FORECAST

Period	Load Forecast (MW)		
	Low	Medium	High
2003-04 to 2007-08	11,434 to 13,521	11,445 to 13,603	11,461 to 13,612
2008-09 to 2012-13	14,168 to 17,318	14,333 to 18,155	14,348 to 18,288
2013-14 to 2017-18	18,166 to 21,973	19,348 to 24,778	19,544 to 25,602
2018-19 to 2022-23	22,970 to 27,331	26,234 to 32,783	27,324 to 36,277
2023-24 to 2024-25	28,481 to 29,623	34,558 to 36,358	38,992 to 41,909

Summary of the load forecast data provided by the Planning Power Department of WAPDA for 20 years period from 2005-06 to 2024-2025 is given below:

Table 2.3-3 SUMMARY OF LOAD FORECAST FOR 20 YEARS (2005-2025)

Period	**WAPDA (MW)**	**KESC (MW)**	**WAPDA+KESC (without Captive) (MW)**	**Captive (MW)**	**Total (MW)**
2005-06 to 2009-10	12,806 to 17,356	2,102 to 2,839	14,908 to 20,195	1,216 to 1,983	16,124 to 22,178
2010-11 to 2014-15	18,910 to 26,769	3,133 to 4,529	22,043 to 31,298	2,250 to 3,567	24,293 to 34,865
2015-16 to 2019-20	28,779 to 38,084	4,890 to 6,621	33,669 to 44,705	3,923 to 5,790	37,592 to 50,495
2020-21 to 2024-25	40,988 to 56,232	7,174 to 10,159	48,162 to 66,391	6,425 to 10,061	54,587 to 76,452

2.4 EFFECTIVE CAPABILITY OF WAPDA SYSTEM

Although the total installed capacity of electric power generation system handled by WAPDA / PEPCO is 17605 MW (Table 2.4-1) but the effective capability varies significantly during the year due to seasonal variations.

Table 2.4-1 TOTAL INSTALLED CAPACITY OF POWER PLANTS - 2010

A. Thermal GENCOs	4,829 MW
B. WAPDA Hydel	6,444 MW
Sub Total (A+B)	**11,273 MW**
C. IPPS and Rental Power	

IPPs Thermal	7,183 MW
IPP Hydel	111 MW
Nuclear (PAEC)	325 MW
Rental Power	286 MW
Sub Total C	**7,905 MW**
D. KESC System	
KESC Thermal	1,955 MW
IPPs Thermal	1,279 MW
KANUPP	137 MW
Sub Total D	**3,371 MW**
Grand Total (A+B+C+D)	**22,549 MW**

During the high water flow months of summer season, the Hydel power capability is at its maximum and this capability remarkably reduces during winter which is the season of low water flow and the hydro electric power generation capability is minimum. However, in winter the thermal capacity is slightly higher as compared to the summer season. The summary of effective capability is given as under:

Table 2.4-2 SUMMARY OF EFFECTIVE CAPABILITY OF SYSTEM

Power Generation	**Summer**	**Winter**
WAPDA Hydel	6,554 MW	3,322 MW
WAPDA Thermal	3,892 MW	3,932 MW
IPPS	5,423 MW	5,423 MW
Total Capability	15,869 MW	12,677 MW
Reduction Compared to Installed Capacity of 18,892 MW	1,450 MW	4,642 MW
Percentage Reduction	8.24%	26.37%

2.5 GENERATION EXPANSION PLAN

The fast growing demand of electric power emphasizes the need for construction and commissioning of additional power plants by the year 2025 and beyond. Thus, speedy and effective measures are required to avert the situation demanding load shedding with grave consequences on country's economy and quality of the people's life.

In this regard there are several Power Expansion Projects, shown in Table 2.5-1, both Hydel and Combined Cycle Power Projects, to be undertaken in public and private sectors.

Table 2.5-1 UPCOMING IPPS GENERATION EXPANSION PLAN (WAPDA SYSTEM)

No.	Project	Sponsor/Company Name	Location	Capacity(MW)	Expected COD
Year 2014					
1	Radian Power Project	Radian Energy	Pasrur, Punjab	150	14-Dec

No.	Project	Sponsor/Company Name	Location	Capacity(MW)	Expected COD
2	Grange Holdings Power Project	Grange Power Limited	Arifwala, Punjab	146.5	14-Dec
3	Star Thermal Power Project	Star Power Generation Limited	Daharki, Sindh	125.84	14-Dec
4	Patrind Hydropower Project	Star Hydropower Limited	Kunhar River, KPK/AJK	147	14-Dec
5	JDW Cogeneration Project	JDWP/JSML	Near Rahim Yar Khan, Punjab	80	14-Dec
Sub Total (2014)				649.34	
Year 2015					
6	Kandra Power Project	Petroleum Exploration Limited	Kandra near Sukkur	120	15-Jun
7	Gulpur Hydropower project	Mira Power Ltd	Poonch River/Gulpur, AJK	100	15-Jun
8	Ramzan Cogeneration Project	Ramazan Energy/Sharif Group, Ramaz Sugar Mills	Bhawana, Jhang Road Chiniot, Punjab	100	15-Jun
9	Sehra Hydropower Project	Farab Company Iran	Poonch River, AJK	130	15-Dec
10	Rajdhani Hydropower Project	Iqbal Power Ltd	Poonch River Near Mangla, AJK	132	15-Dec
11	Janpur Cogeneration Project	Janpur Energy/RYK Mills	Janpur, District Rahim Yar Khan, Punjab	60	15-Dec
Sub Total (2015)				642	
Year 2016					
12	Kotli Hydropower Project	Mira Pakistan Ltd	Poonch River/Kotli, AJK	100	16-Jun
13	Karot Hydropower Project	China International Water & Electric Corp (CWE)	Jehlum River, AJK	720	16-Jun
14	Madian Hydropower Project	Cherat Cement PAK	Swat River, KPK	157	16-Jun
15	Fatima Cogeneration Project	Fatima Energy/Fatima Sugar Mills	Sanawan, Kot Addu, Muzaffargarh, Punjab	100	16-Jun
16	AES Imported Coal Project	AES Pakistan (Pvt) Limited	Gadani Near Karachi	1,200	16-Dec
17	Azad Pattan	Alamgir Power Pvt	Jehlum River/Sudhnoti,	222	16-Dec

No.	Project	Sponsor/Company Name	Location	Capacity(MW)	Expected COD
	Hydropower Project	Ltd	AJK		
18	Asrit-Kedam Hydropower Project	Younas Brothers	Near Kalam/Swat River, KPK	215	16-Dec
19	Chishtia Cogeneration Project	CPL/CSML	Sillanwali ? Sahiwal road District Sargodha, Punjab	65	16-Dec
20	Dewan Cogeneration Project	Dewan Energy Ltd	Dewan City 20 Km from Sujawal on Sujwal-Badin Road, Sindh	120	16-Dec
Sub Total (2016)				2,899.00	
Year 2017					
21	Kohala Hydropower Project	China International Water & Electric Corp (CWE)	Jehlum River/Kohala, AJK	1,100	17-Dec
22	Chakothi-Hattian Project	Suhail Jute Mills	Muzaffarabad, AJK	500	17-Dec
23	Shogosin Hydropower Project		Luthko River/Chitral, KPK	132	17-Dec
24	Shushgai Zhendoli Hydropower Project		Turkho River/Chitral, KPK	144	17-Dec
25	Suki Kinari Hydropower Project	S.K Hydro	Kunhar River/Mansehra, KPK	840	17-Dec
26	Kaigah Hydropower Project	Telecom Valley Pvt Ltd	Kaigah/Indus River, KPK	548	17-Dec
Sub Total (2017)				3,264	
GRAND TOTAL (A)				7,454.34	

2.6 ROLE OF PROPOSED POWER PLANT

Pakistan is facing acute energy shortage. Due to growing economic conditions, the power requirement is also increasing day by day. Government of Punjab is committed to combat energy shortage using all possible energy resources. Indigenous Coal is one of the priorities. The proposed coal based power plant will play a vital role in adding 1×300 MW in the National Grid System through which many Industrial units, Urban and rural areas shall be benefited and enter into the main stream of development and prosperity.

2.7 POWER PLANT CONNECTION TO GRID

According to Interconnection Study for Evacuation of Power from 300 MW Coal-fired Power Plant at Pind Dadan Khan to the National Grid (Report-1), it is proposed one option for the power plant connecting to WAPDA: the option is connecting to the nearby 132kV substations with five 132kV outgoing lines.

In this phase, 1×300MW net output power plant shall be installed by CMEC. According to the connection plan above, the electrical primary system adopts the following scheme:

- The unit shall be connected with 132kV grid through generator-transformer
- The GCB shall be provided.
- The 132kV switchgear shall be sited in power plant which shall be connected with gird through five (5) outgoing lines.
- One (1) SST transformer shall be sited in power plant which power shall be gained for 132kV gird.

The final scheme shall be revised according to net study.

3.0 FUEL

3.1 COAL SOURCE

The east Salt range where this Project is located can be divided into three mining zones, Dalwal Zone, Padhrar Zone and Ara Basharat Zone in Punjab province, Pakistan.

3.1.1 Dalwal Zone

The potential new mining area in Dalwal Zone is estimated to hold 103.42 million tons of coal resources. In the middle of the potential new mining area, there's an estimated reserve of 22.49 million tons of coal resources and 43.63 million tons of carbonaceous shale with high calorific value, amounting to 66.12 million tons of coal and coaly shale in total. In the north and west part of the potential new mining area, there's an estimated reserve of 80.93 million tons of coal resources.

In the middle of the potential new mining area in the Dalwal Zone, the potential new mining area can be divided into three mines, with boundary at Maghal village. The coal mine in the west, referred to as No. 1 Dawal Mine, has reserves of 39.08 million tons (including carbonaceous shale), and the exploitative reserves of 29.31 million tons. The designed capacity of this coal mine is set at 450,000 tons/year. The No. 2 Dalwal Mine is located between the BH25 drilling hole and the east area with reserves of 11.79 million tons (including carbonaceous shale) and the exploitative reserves of 8.84 million tons. The designed capacity of this coal mine is set at 210,000 tons/year. The No. 3 Dalwal Mine is located in the east of the BH25 drilling hole with reserves of 14.23 million tons (including carbonaceous shale) and the exploitative reserves of 11.42 million tons. The designed capacity of this coal mine is set at 300,000 tons/year. The No. 4 Dalwal Mine will be independently located at the south of Khandoyn vallage in the southwest of Dalwal Zone with reserves of 7.46 million tons and the exploitative reserves of 5.6 million tons. The designed capacity of this coal mine is 150,000 tons/year

Two wells will be located at the west of Khandoyn vallage in the west of Dalwal Zone, with reserves of 19.71 million tons and the exploitative reserves of 14.78 million tons. The advanced well shall be the No. 5 Dalwal Mine well located at the north of Ransial village with reserves of about 9.7 million tons and the exploitative reserves of about 7.28 million tons. The designed capacity of this coal mine is set at 150,000 tons/year.

Overall, the total five coal mines shall be set in the early development of central Dalwal Zone, and the total raw coal production capacity is estimated to be 1.26 million tons (= 45 + 21 + 30 + 15 + 15).

Resource reserves of about 63.77 million tons between the west of Khandoyn village and the south of Ransial village are available in the west of Dalwal Zone. They can be used as prospective reserves for replacing early development of the mines, to ensure the balance of production.

3.1.2 Padhrar Zone

The coal resources in Padhrar Zone are featured with relatively complex structure, thin coal seam. One pair of mines, namely No. 1 Padhrar Mine with reserves of 9.21 million tons and the exploitative reserves of 5.99 million tons are planned in Padhrar Zone. The designed capacity of this coal mine is 150,000 tons/year.

3.1.3 Ara Basharat Zone

Ara Basharat Zone is located to the east of Dalwal Zone. This zone is featured with relatively thicker coal seams and relatively simply mining technical conditions. A pair of mines are planned in Ara Basharat Zone, namely No. 1 Ara Bsharat Mine with reserves of 38.73 million tons and the exploitative design reserves of about 29.05 million tons. The designed capacity of this coal mine is 450,000 tons/year.

Overall, in Salt Range mining area, 7 coal mines will be developed, including five (5) mines in Dalwal Zone (with designed production capacity of 450,000 tons/year, 210,000 tons/year, 300,000 tons/year, 150,000 tons/year, 150,000 tons/year respectively), one (1) coal mine in Padhrar Zone (with designed production capacity of 150,000 tons/year) and one (1) coal mine in Ara Basharat Zone (designed production capacity of 450,000 tons/year). The total designed production capacity shall be 1.86 million tons/year and it could meet the demand of coal of 1X300 MW (net) coal fired thermal power unit in 30 years.

3.2 COAL ANALYSIS

Coal and ash composition analysis are listed in the table below, all coal sampling and test will be finished in February, 2015, the data herewith is likely to be revised and supplemented.

Item	Symbol	unit	Design coal	Check coal
Total moisture(arb)	Mt	%	15（interim）	20（interim）
moisture(adb)	Mad	%	provided later	provided later
Ash as received	Aar	%	30（interim）	35（interim）
carbon as received	Car	%	40（interim）	35（interim）
Hydrogen as received	Har	%	provided later	provided later
Oxygen	Oar	%	provided later	provided later
Nitrogen	Nar	%	provided later	provided later
Sulphur	St.ar	%	2.5（interim）	3（interim）
Volatile matter	Vdaf	%	40（interim）	45（interim）
Low heat value	Qnet,v,ar	kcal/kg	4200（interim）	4000（interim）
	HGI		provided later	provided later
abrasion index	Ke		provided later	provided later
Ash fusion	DT	℃	provided later	provided later
	ST	℃	provided later	provided later
	HT	℃	provided later	provided later
	FT	℃	provided later	provided later
Ash analysis				
	SiO2	%	provided later	provided later
	Al2O3	%	provided later	provided later
	Fe2O3	%	provided later	provided later
	TiO2	%	provided later	provided later
	P2O5	%	provided later	provided later
	CaO	%	provided later	provided later
	MgO	%	provided later	provided later
	K2O	%	provided later	provided later
	Na2O	%	provided later	provided later
	MnO2	%	provided later	provided later
	SO3	%	provided later	provided later
Free silicon dioxide in coal	SiO2（F）	%	provided later	provided later
Fluorin	Far	μg/g	provided later	provided later
Chlorine	Clar	%	provided later	provided later
Arsenic	Asar	%	provided later	provided later
Cadmium	Cdar	μg/g	provided later	provided later
Chromium	Crar	μg/g	provided later	provided later
plumbum	Pbar	μg/g	provided later	provided later

Item	Symbol	unit	Design coal	Check coal
Copper	Cuar	μg/g	provided later	provided later
Nickel	Niar	μg/g	provided later	provided later
Zinc	Znar	μg/g	provided later	provided later
Iron	Fear	μg/g	provided later	provided later

3.3 COAL CONSUMPTION

Interim consumption of coal (BMCR condition)

Item	Unit	1x300MW	
		Performance coal	Worst coal
Consumption of coal	t/h	163.2	171.3
	t/d	3916.8	4111.2
	$X10^4$t/a	121.5	127.5

Notes:

a). daily available operation hours shall be 24 hours.

b). annually available operation hours shall be 7446 hours (average value in five years, Allowances shall be granted in the PPA for first year after COD and major maintenance year during operation).

c). the hour consumption of coal is BMCR condition.

3.4 FUEL OIL

Assume LDO (light diesel oil) is used for ignition and flame stabilization during low load. LDO is transported to plant by truck.

Assume the LDO analysis:

Sl. No.	Particulars	Unit	LDO (IS:1460, 1995)
1	Flash point	Deg. C min.	66
2	Viscosity @40oC	Cst	2.5 to 15.7
3	Pour Point	℃	12 for Winter 21 for Summer
4	Ash Content, Max	% wt.	0.02
5	Water Content, Max	% vol	0.25
6	Sediments, Max	% wt	0.25
7	Sulphut, Max	% wt	4.0
14	Approximate gross calorific value	Kcal/kg	10,000
15	Density at 15oC (Aproximate)	$Kg.m^3$	850-870

4.0 SITE CONDITIONS

4.1 SITE SUMMARIZATION

The study area belongs to Punjab province of Pakistan. The sites shall be located in the northwest about 230km away from the capital city of Lahore, about 100km away south of the capital Islamabad. The landform shall be plain on top of and in front of salt range, with some valleys around. The altitude of sites ranges from 450 to 850m.The altitude of north zone of salt range shall be less than 570m; top zone of salt range shall be from 740m to 800m, south zone of salt range shall be less than 250m. The area belongs to subtropical continental climate, the maximum average temperature shall be 40℃, the minimum temperature of 6℃, the annual average temperature shall be 24.2℃. Winter lasts from December to next February every year, rainfall shall be mainly concentrated in July to August, the average annual rainfall is 600~800mm, the main agricultural products in the area are rice, cotton, corn, sugar cane and e.g.

4.2 TRANSPORTATION

There are two transportation ways, railway and road .The railway is along the Jhelum River, in south zone of salt range. There are several roads connecting big villages and towns, but many of the roads are not good, are narrow and broken, except the M-2 expressway, a best road from Lahore to Islamabad. There is seems an airport west about 6km away from Chakwal city. There is no water carriage in this area.

4.3 METEOROLOGY

Generally, the project area experiences a subtropics climate characterized by hot and humid weather all year round. The datum from Jan 2009 to Dec 2013 of the Jhelum meteorological station is analyzed for reference. Because of the terrain and climate difference between the plant site and the Jhelum meteorological station, as a result, the analyze result only can be referenced, if new more representational meteorological datum collected, the meteorological elements shall be updated. The ambient temperatures, humidity, rainfall and evaporation are as follows:

- Maximum ambient temperature: 46.1℃
- Minimum ambient temperature: 1.1℃
- Annual average temperature: 24.2℃
- Annual average relative humidity 62%
- Yearly average rainfall 745mm
- Yearly average evaporation amount 1239.1mm

4.3.1 Dry bulb temperatures and relative humidity

The dry bulb temperature data, relative humidity data and vapour pressure data are obtained from the Jhelum meteorological station, the dry bulb temperature data is summarized in table4.3-1, the relative humidity data is summarized in table4.3-2, the vapour pressure data is summarized in table4.3-3.

Table4.3-1 records of mean temperature (2009-2013) unit: ℃

Item	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Monthly Mean Max	19.1	21.8	29.1	34.0	39.9	40.8	36.6	34.2	34.6	33.1	27.8	22.4	40.8
Monthly Mean Min	4.9	8.3	13.6	18.6	23.6	26.3	25.9	25.6	23.6	19.9	10.5	5.3	4.9
Highest Max	24.1	26.9	34.3	39.4	46.1	45.5	42.0	38.2	37.2	36.7	31.5	27.1	46.1
Lowest Min	2.3	4.4	8.7	14.3	16.9	21.1	21.8	21.6	19.3	11.7	6.2	1.1	1.1
Daily Range	14.3	13.5	15.5	15.4	16.3	14.5	10.7	8.7	10.9	15.2	17.2	17.1	14.1
Average	12.0	15.1	21.3	26.3	31.7	33.5	31.3	29.9	29.1	26.5	19.2	13.9	24.2

Table4.3-2 records of mean relative humidity (2009-2013) unit: %

Time	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
5:00 AM	2009	89	81	74	64	50	48	73	84	84	77	85	84	74
	2010	91	82	79	55	54	59	82	90	87	86	86	85	78
	2011	89	85	79	74	62	68	90	88	89	84	84	85	81
	2012	85	77	74	70	51	49	76	90	91	85	88	89	77
	2013	89	87	85	75	52	65	85	90	87	84	86	86	81
5:00 PM	2009	84	41	33	30	17	19	43	59	51	33	48	48	42
	2010	81	41	34	19	23	28	55	68	56	52	46	51	46
	2011	47	52	40	36	27	40	66	65	60	48	48	47	48
	2012	45	38	29	33	20	20	48	68	66	54	56	60	45
	2013	33	54	46	41	20	33	58	70	61	53	54	58	48
	Average	73	64	57	50	38	43	68	77	73	66	68	69	62

Table4.3-3 records of mean vapour pressure (2009-2013) unit: hpa

Time	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
5:00	2009	10.3	10.8	12.6	14.4	14.9	16.9	27	30.6	27	15.7	11.5	8.5	16.7

Time	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
AM	2010	8.7	10.8	15.3	14.3	17	20.4	29.8	31.6	26	20.4	12	7.9	17.9
	2011	8.4	10.8	13.5	15.8	20.1	25.3	32	31.5	28.1	18.2	13.3	8.2	18.8
	2012	7.9	8.3	11	16.3	15.5	18.3	29.6	31.6	28.3	17.6	12.3	9.8	17.2
	2013	8.6	11.2	14.7	16.9	15.9	25.5	32	31.9	26.8	20.7	11.3	9	18.7
5:00 PM	2009	12.1	10.8	11.8	11.6	11.5	13.8	26.4	30.8	27	15	14.2	11.1	16.3
	2010	10	10.7	14.4	11.1	14.7	18	29.6	32.7	27.6	23.1	15.8	11.7	18.3
	2011	8.8	11.7	14.5	15.9	18.5	26	33.7	32.4	30.1	21.7	16.6	11.7	20.1
	2012	9.1	8.6	9.9	15.4	13.5	15.5	29.9	33.9	31.2	22.8	17.3	13.1	18.4
	2013	10.3	12.8	17.1	19.1	13.8	22.9	32.6	33.6	29.7	23.6	15.8	12.2	20.3
	Average	9.4	10.7	13.5	15.1	15.5	20.3	30.3	32.1	28.2	19.9	14.0	10.3	18.3

4.3.2 Wind

The wind speed data and wind direction is obtained from the Jhelum meteorological station, the wind speed data is summarized in table4.3-4, the wind direction is summarized in table4.3-5.

Table 4.3-4 Records of wind speed (2009-2013) unit: %

Time	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
5:00 AM	2009	0.1	0.1	0.4	0.7	0.6	0.5	0.6	0.1	0.1	0.0	0.0	0.0	0.3
	2010	0.1	0.5	0.2	0.7	0.6	0.4	0.6	0.5	0.3	0.2	0.2	0.1	0.3
	2011	0.1	0.3	0.4	0.5	0.1	1.0	0.5	0.2	0.1	0.2	0.2	0.0	0.3
	2012	0.2	0.3	0.2	0.5	1.0	0.3	0.6	0.5	0.2	0.1	0.1	0.3	0.3
	2013	0.1	0.7	0.1	0.4	0.4	0.6	0.8	0.4	0.2	0.1	0.2	0.0	0.3
5:00 PM	2009	0.6	1.0	1.3	1.3	1.3	1.1	0.6	0.7	1.0	0.6	0.2	0.1	0.8
	2010	0.6	0.6	0.8	1.5	1.6	1.4	1.6	0.5	0.8	0.6	0.1	0.1	0.8
	2011	0.6	1.1	1.0	1.1	1.0	2.0	1.2	0.9	0.9	0.5	0.3	0.4	0.9
	2012	0.9	0.7	1.5	1.7	1.4	2.3	1.9	0.9	0.7	0.8	0.4	0.4	1.1
	2013	0.8	1.2	1.1	1.3	1.8	1.7	1.3	1.0	0.9	0.7	0.3	0.5	1.0
	Average	0.4	0.6	0.7	1.0	1.0	1.1	1.0	0.6	0.5	0.4	0.2	0.2	0.6

Table 4.3-5 wind direction (2009-2013) unit: %

Time	Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
5:00 AM	2009	N	NW	NW	N	SE	SW	SE	SW	SE	SE	C	C	SE
	2010	NW	NW	NW	NW	NW	NW	NE	NE	W	NE	NW	E	NW
	2011	W	NW	NW	NW	SW	NE	NE	NE	SE	NW	NW	C	NW
	2012	W	NW	C	NE	NW	W	NE	SE	NE	NW	NW	NW	NW
	2013	NW	SE	C	NW	NW	NE	NE	E	NE	NW	NE	C	NW
5:00 PM	2009	NE	SE	SE	SW	SW	SW	SE	SE	SE	S	C	C	SE
	2010	NW	SE	SW	NW	SW	SW	SE	SW	SW	SW	SW	SW	SW
	2011	NW	NW	SW	SE	SW	SE	SW	SE	SW	SW	NW	SW	SW
	2012	NW	NW	SW	SW	SW	SW	SW	SE	SW	SW	SW	SW	SW
	2013	NW	SW	SW	SW	SW	SE	SE	SE	SW	SW	NW	NW	SW
	Domaint	NW	NW	SW	NW	SW	SW	NE SE	SE	SW	SW	NW	SW	SW

4.3.3 Rainfall and Evaporation

The rain data and wind direction is obtained from the Jhelum meteorological station, the data of monthly highest rain in a day is summarized in table4.3-6, the data of monthly highest rain in a day is summarized in table4.3-7, and the evaporation is summarized in table4.3-8.

Table 4.3-6 Records of monthly highest rain in a day unit: mm

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2009	16	23.7	15.5	20.2	11.8	20	39	60	12	0	6	/	23.7
2010	1	67	9	8	28	28	91.6	61.8	25.7	19.1	/	14.6	67
2011	0	27.5	10.6	11.7	5.4	18.4	73.2	72.6	70.2	9.1	/	0	73.2
2012	26.6	9	4	6	13.4	3.5	51	66.6	14	10.4	5.7	22.8	66.6
2013	11.5	31.9	5.8	26.1	10.8	38.8	73.4	102	51	1.2	23.7	0.2	102
MAX	26.6	67	15.5	26.1	28	38.8	91.6	102	70.2	19.1	23.7	22.8	102

Table 4.3-7 Records of monthly rainfall amount unit: mm

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2009	56.6	34.4	21	31.2	22.8	49.5	130	164.3	22	0	11	/	542.8

2010	2	75	18	13.2	51	76.7	259	198.3	60.1	23.4	/	14.6	791.3
2011	1	94.6	15.6	31.5	16.8	54.8	206.8	170.4	146.1	11.7	/	0	749.3
2012	63.8	16.7	2	17.8	19.1	7.3	215.6	265.7	59.3	13	5.7	31.4	717.4
2013	11.8	100.5	9.5	45.5	14	83	296	241.9	87.6	1.8	32.6	0.2	924.4
Average	27.0	64.2	13.2	27.8	24.7	54.3	221.5	208.1	75.0	10.0	16.4	11.6	745.0

Table 4.3-8 Records of monthly evaporation amount unit: mm

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2009	36.7	58.9	88.7	163.7	207.1	248.9	176.5	130.9	119	95	47.1	32.7	1405.2
2010	26.2	46.4	98.9	176.4	200	197.9	168.4	97.1	103.9	83.2	43.9	26.5	1268.8
2011	29.1	35.5	89.3	123.4	188.6	190.6	134.9	113.8	103.5	77	41.4	30.6	1157.7
2012	34.6	47.8	95.5	133.6	208.5	223.3	160.1	105.9	74.8	45.5	44.2	23.6	1197.4
2013	27.5	39.5	81	181	204.4	196	121.5	89.8	84	71	42.6	28	1166.3
Average	30.8	45.6	90.7	155.6	201.7	211.3	152.3	107.5	97.0	74.3	43.8	28.3	1239.1

4.3.4 Flood control standards of power plant site

According to the provisions of "Code for design of fossil fired power plant" (GB50660 - 2011), Flood control standards of power plant site should be equals or exceeds 50-year frequency flood level.

For lack of detailed flooding information, flooding prevention for the power plant site is not considered and the cost is not included in this stage. The detail flood protection measure shall be confirmed according to the hydrological data in the next stage.

4.4 WATER SUPPLY

4.4.1 Water Flow

The total Annual Average Makeup Water Flow for power plant shall be 794m^3/h. The total Summer Makeup Water Flow for power plant shall be 864m^3/h. For detailed water demand for this power plant refers to DWG. No. F1404K-S01-01.

4.4.2 Water source

4.4.2.1 Project area condition

The Project Area is located in the Punjab Province of Pakistan. It is approachable from Lahore and Islamabad by M5 Motor Way and local road from motorway exchange for Lillah and Pind Dadan Khan. It is located northwest of Lahore at a distance of about 230km.

Physiographic ally the area exhibits various types of land forms, characterized by low hills of salt range,

piedmont plain sloping towards south and alluvial plain near the rivers. The relief ranges from 187 meters near Kot Momin to 444meters near Jhelum city while the highest point of the surrounding hills is 1057meters AMSL near Khewra. The altitude ranges from 450 to 850 m with an average value of about 700 m. The drainage pattern is generally dendritic to parallel type. River Jhelum is the main recharge source of the Project Area. It also provides water for irrigations through canals and lift pumps. The discharge of the river is being measured at Qadirabad gauging station from where water is released as per agricultural requirements.

Climatically the area lies in semi-arid to sub-humid tropical continental region showing large seasonal fluctuations in temperature and rainfall characterized by hot summer and cold winters. the temperature ranges from 6 to 45℃, with an annual average temperature of 24.3℃. The annual rainfall ranges from 600 to 800 mm, and occurs mainly during months of July to August.

4.4.2.2 Hydrogeology

a) Groundwater occurs in both consolidated and unconsolidated rocks. The Salt Range comprising consolidated rocks is located north of the Project Area. It is composed of rocks of sedimentary origin ranging in age from Cambrian to Eocene. These rocks are mainly comprised sandstone, shale, salt and dolomite beds. A major thrust fault running north to northwest which is supposed to be developed during Jurassic period.

b) Groundwater movement in the consolidated rocks is through secondary porosity developed due to tectonic activities in the form of fractures and joints. The presence of perennial springs in sandstone of Miocene age indicates presence of considerable groundwater potential for exploitation. Some of the village water supply schemes are based on these perennial springs.

c) The unconsolidated deposits of recent age are of continental fluviatile type composed mainly of clay silt and medium sand. The sand forms the major source of groundwater exploration and exploitation. Sand deposits along the rivers normally contain fresh water. In the Project Area these form an arrow strip in between right bank of River Jhelum and piedmont deposits. Piedmont deposits comprise sand, silt/clay and gravels. Groundwater in these deposits is highly saline due to salt range.

4.4.2.3 Reconnaissance survey

Public Health Engineering Department (PHED) developed water supply schemes for Pind Dadan Khan, Lillah and Khewra. Some village water supply schemes also exist along the River Jhelum. Farmer's tube wells also abstract water for agriculture purpose.

The water supply comprises five tube wells. Data of these tube wells was not available in the PHED office Pind Dadan Khan. However, the well field was visited and water levels and water quality pumped from tube well # 4 was checked using portable electric sounders, TDS, pH meters and temperature probe.

The tube well's operator told us that groundwater pumped from tube well # 5 and the tube well located 31 m north of it deteriorated with time and became saline. Accordingly, these tube wells are no more in use. It indicates that the tube wells were not scientifically located considering their cone of influences that expand laterally as well as vertically with time. Therefore, as a result of expansion of cone of influence and up coning the pumped water became saline.

4.4.2.4 Groundwater conditions

Groundwater in the Project Area exists under water table conditions. Depth to water table measured in the tube wells located in the Pind Dadan Khan well field were:

TW-1 1.47 m; and TW-3 1.83 m

The depth to water table was measured while water was being pumped from tube wells No. TW-2 and TW-4. The depth to water table was almost comparing able to that of stage of the river. It indicates that there is no groundwater mining. It is because of fact that fresh water zone is not very thick and also its width is not large enough to allow groundwater abstractions on large scale. Data on salinity of groundwater pumped from the ICI Pakistan Limited tube wells has been collected and studied by preparing graphs of salinity vs. days since water quality data is available. The salinity data along with graphs to understand changes in the salinity of groundwater pumped from each tube well this show rising and declining trends of groundwater salinity. It appears that salinity increases when water is pumped continuously for comparatively longer time durations and decreases when there is a gap in between pumping phases or pumping phase is comparatively of shorter duration.

4.4.2.5 Groundwater flow pattern

To prepare groundwater flow maps, data on groundwater potential heads are required. This data is not available for the Project Area. Accordingly, groundwater contour maps to understand groundwater flow system in the Project Area cannot be prepared. However, from the reconnaissance survey and distribution of water quality it can be inferred that:

- Saline groundwater, from the Salt Range, flows from north to south towards the River Jhelum;
- Fresh groundwater from the River Jhelum at the right bank flows towards north;
- A water divide exists where groundwater potential heads of saline effluent from the northern side and fresh groundwater from the riverside become equal;
- Width of fresh groundwater zone varies between less than 100 m to about 1000 m.

4.4.2.6 Preliminary groundwater potential assessment

Phase I and II studies have been completed and works for Phase III studies are in progress. The up to date progress achieved so far of Phase III has been described in the foregoing sections of the report. Complete evaluation report on groundwater resources after completion of Phase III studies and

analysis.

Existing water supply schemes are based on the groundwater development. Shallow tube wells have been installed along the bank of River Jhelum. Tube wells of water supply schemes, consisting more than one tube well such as in case of Pind Dadan Khan Water Supply Scheme, some tube wells were reported to become saline with time. Spacing between the tube wells is about 30 m. These tube wells were installed in two rows, one just along the bank of River Jhelum and the second about 30m away from the wells in first row. Tube wells in the second row became saline with time and, therefore, have to be abandoned. It indicates that fresh groundwater aquifer is of limited lateral and vertical extent accordingly storage is not adequate to pump more than the recharge from the river.

To pump sustainable sweet water on long term basis is mainly limited with the recharge from the river. Recharge from the rivers depends upon the wetted area and vertical hydraulic conductivity of the sediments in between river, depth to groundwater level and saturated aquifer. No data is available on vertical hydraulic conductivity of the river material. However, Research Institute of Irrigation and Power Department of the Punjab performed ponding tests to estimate seepage from the canals. Using vertical hydraulic conductivity data of these tests and average active width of the River Jhelum has been used to estimate recharge from the river.

Existing width of the river flow, in the vicinity of the tube wells site, is only 30m. Interviews of the locals reveal that it is a dry season accordingly width of Active River is minimum. In the coming months due to rains and snow melt width of river flow will increase. For the estimation of seepage from the river average active width of the river has been assumed as 300 m.

Analysis of recharge from the River Jhelum are based on the wetted width of the river that changes with climatic conditions, snow melt, releases from the upstream barrage for irrigation, The above analysis indicate that entire water requirements of the power plant may not be met by the sweet ground development. During low flows period's water may become saline due to less recharge as compared to groundwater abstraction. Therefore, some of the power plant's water requirements, particularly during dry season or drought conditions, may be met from saline groundwater which may be available in the vicinity power plant site.

The well field is located in the active flood plain of meandering channels of River Jhelum. Therefore, at some places river channels may have not eroded the clay formation to the desired depth that has encountered at Observation Well # 1 at a depth of 27.5 m, Accordingly sites for the remaining tube wells may be selected by performing electrical resistivity to avoid unsuccessful costly drilling activities.

4.4.2.7 Conclusions and recommendations

Studies and investigations so far carried out reveal that:

-The fresh water aquifer(s) were formed by erosion of old piedmont deposits, containing saline water, by the meandering channels of River Jhelum;

-Accordingly, sweet water aquifer(s) are mainly located along the River Jhelum. Width of aquifer(s) range from negligible to more than2km;

-The site selected for installing tube wells is around 750m wide and estimated length may be around 14 km;

-Three test wells and two observation wells have been drilled. Silty clay was encountered only in Observation Well#1 at a depth of 27.5;

-Vertical and lateral extent of fresh water aquifer(s) is limited accordingly; fresh groundwater storage is comparatively small. Therefore, fresh groundwater abstractions would be limited to the recharge from River Jhelum;

-Recharge from a length of 40 m (130 ft), when active width of River Jhelum is 300m, comes about $50m^2$/hr (0.5 cusec);

-In dry season width of water flow decreases to only 30m that indicates that entire water requirements of the power plant may not be fulfilled by developing fresh groundwater only;

-Some of the water requirements of the power plant may be fulfilled by pumping saline groundwater. Saline groundwater may be available in the vicinity of the power plant site;

-Maximum pumping capacity of each tube well may be around $50m^2$/hr (0.5 cusec);

-Meandering river channels may not have eroded the old sediments completely, therefore, it is recommended that sites for the permanent water supply tube wells may be selected on the basis of electrical resistivity survey;

-The tube wells will be located along the River Jhelum in the active flood area; therefore, these will have to be protected from the flood damages in accordance to the local practices.

4.5 ASH YARD

4.5.1 Type and Capacity of Ash Yard

A dry ash handling system shall be employed for the project. It proposed to adopt a dry ash yard in the project. For there are four cement works near these power plant site, it has favorable conditions for ash's comprehensive utilization , It is proposed that the capacity of ash yard meet the requirement for 5 year's ash and slag storage. All the solid wastes shall be transported to the ash yard for dumping if there is not any way for re-use. It should be further implement and reach agreement of ash's comprehensive utilization in the next stage.

For amounts of power plant's solid waste (with the design coal), see the table below:

1X300MW	Ash and slag	Stone coal	Desulphurization Gypsum
Weight of solid waste	$36.7X10^4$ T/year	$0.61X10^4$ T/year	$17.2X10^4$ T/year
Volume of solid waste	$36.7X10^4$ m^3/year	$0.24X10^4$ m^3/year	$9.05X10^4$ m^3/year

The total capacity for ash yard requires is 230.15.x10^4 m^3. It shall meet the requirement for 5 year's ash and slag storage.

4.5.2 Design of Ash Yard

To manage, the ash yard shall be set up adjacent to the coal yard of power plant. This ash yard is the flat land ash yard. An enclosure dyke 2.5m in height shall be constructed of compacted earth with a 3.0m top width and a 1:2.5 side slope.

In the ash yard establishes the draining water vertical shaft, with draining water blind ditch connection, storehouse in rain water through draining water blind ditch conduction current to diking downstream ash water evaporation pond.

The bottom of the yard shall be paved with 1mm HDPE geomembrane to prevent contaminated rainwater from the landfill infiltrating into underground water and causing pollution.

Ash and slag shall be wetted in the plant and transported to the ash yard with automobile. The unloaded ash shall be spread, compacted and piled in layers with a surface slope of 1:30. When the piled height of the ash is higher than the top level of the initial closing levee, the pile surface slope should be reduced to 1:3.5. As the ash pile height increases, the sides of the pile should be covered by brick. When the ash pile reaches final heights (15m), the top shall be covered with a 500mm thick soil layer for planting grasses.

Table 1: List of main construction work in ash yard

	diking		Draining water vertical shaft		Draining water blind drain		Evaporation Pond	
	Height (m)	Length (m)	Inside diameter (m)	Length (m)	Section (m2)	Length (m)	L×W (m)	Depth (m)
Ash yard	2.5.	1800	3.0	15	5.76	185	15.×15	2

Table 2: List for land expropriation and Storage Capacity of ash yard

Ash yard	Ash yard
Expropriation area (10^4m^2) (5 years)	19.16
Storage capacity of ash yard (10^4m^3) (5 years)	231.0

Ash dumping facilities and other facilities shall be build nearby the ash yard.

4.6 ENGINEERING GEOLOGY AND SEISMIC

4.6.1 Regional Geology

Currently, we have no detail information related to regional tectonics. We are working on collecting the faults distribution maps and the description of the holocene active faults of captive site or area nearby.

4.6.2 Seism-Geology

According to the seismic zoning map, it is presumed, the seismic acceleration is 0.1g, and the seismic precautionary intensity is 7 degree as per Chinese code for seismic design of buildings (GB50011).

4.6.3 Engineering Geology

4.6.3.1 Topography

The site is located in alluvial-proluvial plain. Now is the farmland or grassland, and the land is flat and open. The site is close to canal. And adverse geological actions are not found.

4.6.3.2 Stratum and Lithology

According to geological reconnaissance/investigation, the soil deposits in proposed site are made up of the Quaternary alluvial strata, including silt and silty sand. The soil description is as follows:

① silty sand and silt: brownish orange to light yellow, wet to saturated, loose to slightly dense, the characteristic values of bearing capacity ranges from 80 to 150kPa, and layer thickness ranges from 3 to 10m.

② silty sand and silt: brownish orange to light yellow, saturated, slightly dense to medium dense, the characteristic values of bearing capacity ranges from 150 to 200kPa, and layer thickness is more than 15m.

Further investigation and evaluation shall be carried out in the next stage.

4.6.3.3 Groundwater

According to reconnaissance/investigation, the ground water existing at project site is classified as the phreatic water, and the water table ranges from 0 to 8m below the existing ground level. General fluctuation of 1 to 3m in the groundwater is estimated due to seasonal variations, canal and irrigation.

Further investigation and evaluation of the groundwater shall be carried out in the next stage.

4.6.3.4 Foundation

The main soil layer in project site is silty sand and silt, and density degree of the subsoil is loose to slightly dense, which indicates the poor engineering properties, and is not competent enough as the bearing stratum for the shallow foundations. Therefore, for Main Building pile foundation is recommended, and cushion or composite foundation can be considered as the preliminary ground treatment means for the accessorial buildings.

5 PLANT TECHNICAL SPECIFICATION

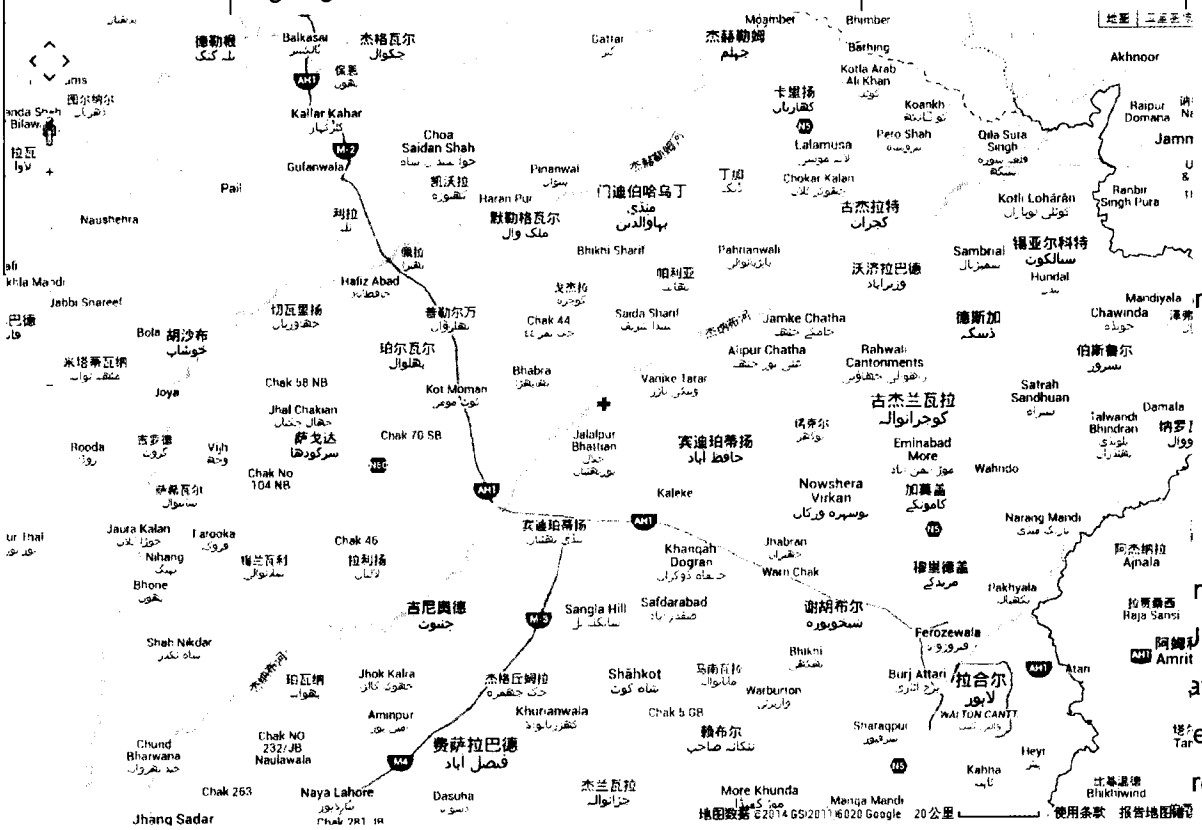
5.1 CAPACITY, SCALE, TYPE OF POWER PLANT AND CONSTRUCTION SCHEDULE

Considering the power demand and local coal production as well as amount of coal resource, 1x300MW (net) coal based thermal subcritical power plant shall be recommended.

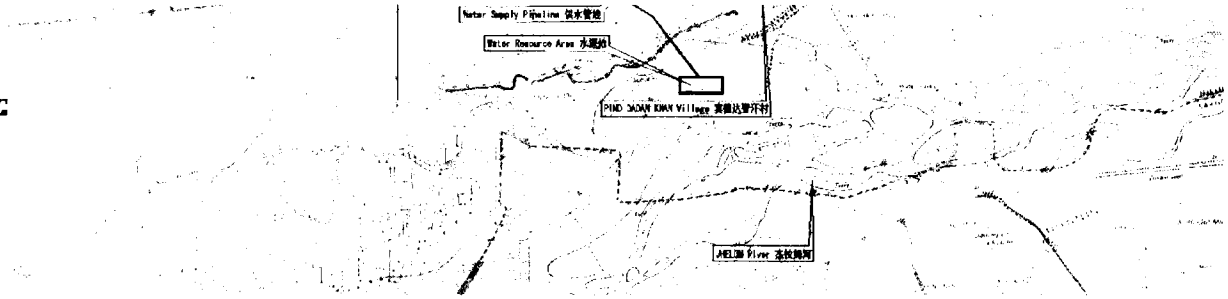
PC boiler shall be adopted for the project.

The Project is expected to be completed within 40 months after the Financial Close, which is in line with the requirements specified by NEPRA for plants of this capacity. As per the estimated time schedules required by related authorities, the preliminary plan for this project is indicated as follows:

Date	Target	Remark
Nov 19, 2014	LOI issued by PPIB	Already issued
Jan 22, 2015	Submission of Tariff Petition & Generation License to NEPRA	
April 30, 2015	Tariff approval and issuance of Generation License	
May 30, 2015	LOS	
June 30 2015	Signing PPA/IA	



JHELUM River



Picture2: Overall planning of power plant

5.2.1.2 Plant capacity

1X300MW coal-fired unit shall be constructed in this phase and extension probability of power plant tentatively is not considered in this stage.

5.2.1.3 Plot Plan

The fixed end faces north, extend towards south; outgoing line from power plant shall be towards east. The plot plan shall be three column layout pattern in which the switchyard, the main power building and the coal yard shall be set from east to west.

5.2.1.4 Outgoing line

The generator shall be connected to 132kV substation and the outgoing line corridor shall be located to the east of main building, which is wide and convenient.

5.2.1.5 Water supply

Groundwater shall be used as water source for this project and necessary wells shall be drilled near JHELUM River. The pipelines shall be arranged as short as possible.

5.2.1.6 Drainage

The plant drainage is the separate drainage system. The Drainage system in plant is comprised of industrial waste water drainage system, domestic sewage water drainage system, rain water drainage system, coal polluted water drainage system. Rainwater in the main building area shall be collected by pipe, in other area shall be collected by ditch, then all shall be pumped to outside of power plant

5.2.1.7 Flood control

The power plant site located at the north of JHELUM River and the distance is about 4km. lacking of hydrologic data, the flood control shall not be considered temporarily in this phase.

5.2.1.8 Coal handling

Coal fuel of this project will adopt the coal from Salt Range, mostly in the D1 and D2 area of DALWAL zone. The coal source lies to the north of site. A coal-washing plant shall be constructed near power plant and the coal-washing plant shall not in the scope of power plant. The coal shall be delivered from the coal-washing plant to power plant by conveyor. The coal-washing plant is assumed at north of power plant with a distance of 1000m in this phase. The coal shall also be transported by truck from Coal-Washing Plant as the capacity of conveyor is not sufficient.

5.2.1.9 Ash Yard

Ash yard shall be located at west of power plant, close to the boundary wall of power plant. It is far from living building and the administration building.

5.2.1.10 Construction and living Area

Construction area shall be at the extended end of power plant, about 10 ha. land need to be rented .Living area will near construction area, which needs to rent about 2 ha. land.

5.2.1.11 Living Quarter of power plant

A living quarter will be constructed at southeast of power plant, and near the access road, about 7.5ha. land will be occupied. Total area of Living area for living quarter is 20000m^2. The buildings are foreseen as a concrete or brick building Including dormitory buildings, sports centre, shop and clinic.

The land requirement for the power plant refers to the following

ITEM	UNIT	LAND AREA	TYPE OF USE	REMARK
total area	ha.	84.23	expropriate	Inside boundary wall
area of site	ha.	20	expropriate	
area of external road	ha.	2.85	expropriate	
area of external coal trestle	ha.	0.6	expropriate	
area of external wells	ha.	0.12	expropriate	
area of ash pond	ha.	19.16	expropriate	
area of living quarter	ha.	5.5	expropriate	
area of construction	ha.	10	rent	
area of living for construction	ha.	2	rent	
area of water pipes	ha.	24	rent	

5.2.2 General Arrangement and Vertical Design

5.2.2.1 Plot plan

The proposed general layout considered not only easy maintenance, access, short links for piping and cabling, but also environment protection of the power plant. Buildings (structures) are arranged according to technical process and areas of similar functions are planned together for convenient operation and maintenance and shortening the pipe length as possible.

The site is made up of main power building, substation, water treatment area, coal yard, auxiliary buildings area, etc. The plant plan shall be three column layout pattern in which from east to west the switchyard, the main power building and the coal yard shall be set. The coal trestle will connect to the main power building from the back of boiler. The area inside boundary wall in this phase is about 20

hectares. The construction area is about 12 hectares.

5.2.2.2 The construction condition

(1) Construction area condition

The construction area and the living area is about 12 hectare, which is at the extended end of power plant. A gentle designed slope is adopted because the topography of construction area is flat; the earth volume of construction area is about 5×10^4 m^3.

(2) The large equipments transportation

The large equipment shall be transported from China to Karachi jetty by ship, and then transported to Lahore-Islamabad Motorway by truck through Choa Saidan Shah Road and Kalar Kahar Road to the power plant.

(3) Power Supply of Construction

a. Electricity Supply for Construction:

The peak electrical load of construction is about 1500kW. The transformer capacity is about 2200kVA, the power of construction is connected nearby with 10kV power line which is about 5 km long.

b. Water supply for construction：

The peak water requirement of construction is about 130t/h. The establishment of water supply will be constructed early in order to supply water in construction period. (I.e. permanent and temporary combination).

c. Communication for Construction：

Communication facility will be constructed for temporary and permanent use at one time; communication line will be connected from the nearby town. The communication line is about 5km long. The wireless communication will be another secondary method

d. Local material supply：

The local material such as brick, tile, stone, lime, sand, etc.could be reach the requirements of construction.

The detail information is shown in the drawing No. F1404K-Z01-02.

5.2.2.3 Landscape

Indigenous trees and flower plants shall be used in where required. Types shall be specified which are resistant to climate and ground conditions.

5.2.2.4 Road

(1) Access Road

The main entrance towards east, the access road will connect to the existing road at south of power

plant and enter from east. The access road shall be 7m wide reinforced concrete pavement, about 1100m long. The interface of inside road and outside road is 1m outside of the power plant wall.

(2) Coal Transportation Road

The coal transportation road will connect to the existing road at east of power plant and enter from north The coal transportation road shall be 7m wide reinforced concrete pavement, about 3km long. The interface of inside road and outside road is 1m outside of the power plant wall.

Coal for this project shall be carried by two ways. A part is carried by coal conveyor from the coal washery and another part is transported by truck from coal mine. Coal transportation by truck will depend on the east road and south road which can connect the power plant and coal mine Salt Range, but the condition of these two roads are not good, and go through several large village and mountains. Therefore the coal transportation route way is very important for the power plant , the contractor should submit a qualified company to study the feasibility of coal transportation route way.

(3) Ash and Slag Transportation Road

The ash and slag transportation road will draw from west to the ash yard. The road shall be 7m wide reinforced concrete pavement, about 100m long. The interface of inside road and outside road is 1m outside of the power plant wall.

(4) Inside Road and Outdoor Paved Ground

The general layout shows the internal roads generally. Roads shall properly be designed according to layout of buildings and technical requirements.

The internal road shall be reinforced concrete pavement.

The design load of road shall be 20t for one truck.

The road around the main power building, coal transportation road, ash transportation road and other main roads shall be 7m wide; other sub roads shall be 4 m wide. Approach road will connect all building entrance to the main roads, its width should match to the width of the door, usually 3m～5m. The turning radius of road shall be 6m～15m, sidewalk 2m.

Sidewalks shall be cast-in-place concrete or paved by concrete brick, 1.5～2.5m wide.

The outdoor ground for maintenance in back of boiler will also be concrete.

Headroom above road within the plant is no less than 5.0m.

(5) Large equipment transportation

The large equipment shall be transported from China to Karachi jetty by ship, and then transported to Lahore-Islamabad Motorway by truck alonging Choa Saidan Shah Road and Kalar Kahar Road to the power plant.

The road from Karachi jetty to Lahore-Islamabad Motorway are generally highway or national road, the Choa Saidan Shah Road and Kalar Kahar Road are allasphalt roads with two roadways and the pavement is well. So the route of large equipment transportation is feasible, but finally shall be confirmed in special transportation report.

5.2.2.5 Piping Arrangement

Proper layout of all kinds of pipe lines is required (including cable conduct, culvert, overhead line and direct-buried pipes).

All the pipe lines in the plant shall be planned systematically, and comprehensively for attaining the shortest distance, the least cross points and shall be buried as well as the convenience of construction, operation and maintenance.

Different pipe lines will keep a certain interval for avoiding affecting each other. Similar pipe lines shall be combined in a same ditch and on same support for shortening the width of pipe corridor.

Headroom above road when overhead pipeline racks go across road is no less than 5.0m.

5.2.2.6 Wall and Fence

(1) Boundary Walls and Gates

Enclosure around power plant shall be 2.4m high brick wall with wire net. The gate in main entrance and gatehouse shall be designed by architectural engineer. The gates of entrance for coal transportation and for ash transportation shall be 9m electric retractable door.

(2) Internal Walls and Gates

Enclosure around H2-generation station shall be 2.5m high brick wall. Enclosure around fuel oil tank area shall be 2.2m high brick wall. All gate of above areas shall be 5m wide.

(3) Internal Fences and Gates

Enclosure around transformer shall be 1.5m high fence. Enclosure around substation shall be1.8m high fence. Gate for substation shall be 4m wide, for transformer area shall be 2m wide. Those gates shall be made of steel.

5.2.2.7 Rainwater Drainage

Rainwater in the main building area shall be collected by pipe, in other area shall be collected by ditch, then all shall be pumped to outside of power plant

5.2.2.8 Vertical Design

According to observation on the spot, we see the north of site is higher than south, with gentle sloping in whole sited. So the site will adopt flat pattern, with gentle slope. Lacking of natural topographic map of site and hydrologic data of JHELUM River, the final site elevation shall be confirmed later.

The difference elevation between indoor and outdoor of building shall be about 0.3 ~ 0.5m.

5.3 Main Equipment

5.3.1 Boiler

The steam generator and associated equipment shall be designed for outdoor installation, single reheat, natural circulation, balanced draft, drum type, sub-critical, pressurized furnace, all steel structure, complete hanging construction, firing coal.

The data is interim and will be revised slightly when the final coal analysis finish in February, 2015.

ITEMS	UNIT	BMCR	TMCR
Steam flow rate of super-heater outlet	t/h	1091	1039
Steam pressure of super-heater outlet	MPa (a)	17.5	17.43
Steam temperature of super-heater outlet	℃	543	543
Steam flow rate of re-heater outlet	t/h	901.4	860.9
Steam temperature of re-heater outlet	℃	543	543
Steam pressure of re-heater outlet	MPa (a)	3.716	3.79
Steam temperature of re-heater inlet	℃	337	332
Steam pressure of re-heater inlet	MPa (a)	3.916	3.95
Boiler guaranteed efficiency (based on LHV, performance guaranteed coal)	%	92.5	

Note:

1. "g" in the pressure unit means gauge pressure and "a" means absolute pressure.
2. Boiler B-MCR working condition corresponds to working condition of steam turbine VWO. Maximum continuous output of the boiler is examined under the working condition.

5.3.2 Steam Turbine

The steam turbine will be sub-critical pressure, single reheat, combined HP-IP turbine, two casing and water cooling steam turbine with bleeds for condensate and feed water pre-heating including deaerator. The turbine will be directly connected to a 50 Hz, three phase A.C. water-hydrogen-hydrogen cooled generator.

The turbine will be provided with bleeding points for feed water pre-heating. Number of feed heating stages will be selected by the Contractor based on the selected main steam values and the final feed water temperature.

The turbine itself will be completely equipped, including live steam line emergency stop valves, turbine control valves, feed heating steam line isolating valves and power assisted non-return valves in feed heating and deaerator tank bleed lines

The Digital Electro-Hydraulic control (DEH) will be used for turbine control system. The system will have the capability of automatically controlling the turbine speed to prevent the unit from reaching over speed tripping point in the event of an instantaneous change in load from full load to no load.

The unit operation mode shall be constant-sliding –constant, with turbine nozzle + throttle governing mode

According to IEC -45,steam turbine and generator is able to operate continuously in a safe manner under the following conditions The power output by the output end of the generator (static excitation ,after deducting the auxiliary power) is defined the maximum continuous output (T-MCR), the condition is defined as heat consumption guarantee condition .

(1) The main steam and reheat steam parameters are rated values and with specified steam & water quality;

(2) The back pressure is rated value 6.8kPa(a)（temporary）;

(3) The makeup water rate is 0%

(4) Regenerative extraction operates normally, but does not carry auxiliary steam.

(5) The generator efficiency is rated value, hydrogen pressure is rated pressure and the rated power factor is rated value,.

(6) Specified final feedwater temperature;

When the generator set in summer back pressure net output (deducting static excitation, the consumed auxiliary power) for 303.6MW except admission quantity and back pressure conditions others same with TMCR is defined summer conditions, in this condition means When Dry bulb temperature below 31.8℃, according to the suited cooling system, turbine output is 324MW,if the Dry bulb

temperature exceed 31.8℃,216 hours non-full load capacity is estimated.

Rated power(TMCR)	330MW
Rated inlet steam flow(TMCR)	1039t/h
Steam pressure at main stop valve inlet(TMCR)	16.67MPa(a)
Steam temperature at main stop valve inlet(TMCR)	538℃
Reheat steam flow(TMCR)	860.9 t/h
Reheat steam pressure at IP combined stop valve inlet(TMCR)	3.821MPa(a)
Reheat steam temperature at IP combined stop valve inlet(TMCR)	538 ℃
LP exhausting steam pressure(TMCR)	6.8kPa(a
Feed-water temperature(TMCR)	278.2℃
Number of feed-water regenerative stages	8
Rated speed	3000

5.3.3 Generator

The main technical characteristics shows as follows,

1	1X330MW Generator	
1.1	Frame Size	1X3 ph
1.2	Terminal voltage	20KV
1.3	Frequency/speed	50Hz / 3000 rev/min
1.4	Rated Power Factor	0.85

5.4 STEAM GENERATOR AUXILIARY SYSTEM

Coal analysis refers to section 3.2.

Coal consumption refers to section 3.3.

5.4.1 Primary air system

The cold air is intake by PAF through the silencer which installed at the inlet duct of PAF. The design and arrangement of primary air system shall enable the operation of single PAF under boiler low load conditions, so interconnecting duct shall be arranged between two PAF outlet ducts, downstream of the PAF outlet motor damper. The interconnecting duct capacity is 30% of the required air flow at BMCR condition. One motor damper is provided in the interconnecting duct. After the interconnecting duct and before into air preheater, one motor damper is set.

The cold air of the PAF outlet is divided into two parts. One part through air preheater, be heated by flue gas, come into manifold in front of mills, and then connected to each mill through five branch duct. The other part cold air also comes into another manifold in front of mills, and then connects to each hot PA branch duct. Pre-mixing shall be done before both cold air and heated air enter into pulverizer, and

finally convey the pulverized coal into furnace.

The functions of manifold in front of mills are not only transport cold air and hot air into each pulverizer averaged, but also balance draft. In the each hot air branch duct before mixing, one shut-off damper (isolation-pneumatic damper) and one motor control automatic damper are provided in series. In the each cold air branch duct before mixing, one motor shut-off damper (isolation-electric damper) and one motor control automatic damper are provided in series. The isolating dampers are capable of shutting-off tightly to prevent leaking of hot air into pulverizers (bring on coal firing or exploding), and be sealed by sealing air if necessary to prevent leaking of hot air into environment.

Two (2) 50% capacity fans are installed.
Type: centrifugal flow type
Flow margin: not less than 25%
Pressure margin: not less than 35%
The system is shown in the drawing 60-F1404K-J01-02.

5.4.2 Secondary air system

Secondary air pressurized by Forced Draft Fan (FDF) passes through secondary section of the air heater and then through the secondary air duct and windbox to burners.

Atmospheric air is taken through a silencer into the inlet of each axial flow fan.
The secondary air system provides hot air to support combustion of fuel in the furnace. Two 50% capacity fans are installed.

Number: two (2)
Type: moving blade adjustable axial flow type
Flow margin: not less than 10%
Pressure margin: not less than 15%
SCAH (steam coil air heater) is set before air preheater.

The interconnecting duct capacity is 30% of the required air flow at BMCR condition. One motor damper is provided in the interconnecting duct. After the interconnecting duct and before into SCAH, one motor damper is set.

5.4.3 Flue Gas System

The gas flow discharges at the flue gas outlet side of the regenerative air pre-heater ducting. Induced Draft Fan (IDF) fan discharges the flue gas through the electrostatic precipitator, then to the stack. Induced draft fans shall be axial flow type induced draft fans.

Two 50% capacity fans are installed.

Type: static blade adjustable axial flow type

Flow margin: not less than 15%

Pressure margin: not less than 20%

There are two ESP for one boiler, and ESP shall be double chamber five field type, and grantee the dust emission value below 50mg/Nm^3 (6% O2, dry base) for performance coal at BMCR.

Through adopt low NOx technology, control the NO_X emission lower than 510mg/Nm^3.

One set of limestone-gypsum wet FGD shall be set to satisfy the emission requirement.

The Particulates Emission shall be lower than 50 mg/Nm^3 before chimney.

The system is shown in the drawing 60-1404K-J01-02.

5.4.4 Seal air system

Two 100% capacity seal air fans are installed for mill sealing, one (1) in operation and one (1) in stand-by.

The system is shown in the drawing 60-1404K-J01-02

5.4.5 Coal pulverizing system

The coal pulverizing system shall be the coal air direct firing system, Coal feeders feed required quantities of coal to pulverize where the coal is pulverized and dried. The pulverized coal shall be directly supplied to burners via the pulverized coal pipes. Five (5) middle speed mills shall be provided, four in operation and one in stand-by for performance coal and five in operation for worst coal. The total capacity of the operation mills will meet the full requirement corresponding to boiler MCR additional and the margin is not less than 10% for the performance coal.

Raw coal bunker shall be steel plate structure. The inlet dimension is ø8000mm; the outlet dimension is about ø 800mm.The effective capacity of four (4) raw coal bunkers will meet the coal consumption of 10 hours at boiler MCR load for performance coal.

And the effective capacity of five (5) raw coal bunkers will meet the coal consumption of 8 hours at boiler MCR load for worst coal.

One (1) sets of Electronic Gravimetric Coal Feeder with be provided for each mill.

The system is shown in the drawing 60-1404K-J01-03.

5.4.6 Fuel Oil System

LDO shall be used for boiler ignition and low load stabilization combustion. One completely set of oil storage and feeding facilities shall be provided.

The oil system include the below equipment:

1, two (2) 1000m^3 LDO tank

2, two (2) 100% capacity oil unloading pump

3, two (2) 100% capacity oil unloading rough strainer

4, Three (3) 50% capacity oil supply pumps

5, Three (3) 50% capacity oil supply fine strainer

6, one (1) set of oil- water separator

7, one (1) 100% capacity drain oil pump

8, one drain oil underground pit

The system is shown in the drawing 60-F1404K-J01-04.

5.4.7 Air compressed system

The compressed air shall be supplied from air compressor room which is charged by Ash Handling part.

5.4.8 Air and flue gas duct

5.4.8.1 Air and flue gas duct velocity

Air and flue gas system flow velocity is limited herein after;

No	Air and flue gas duct	unit	Max. value
1	Cold primary air duct	m/s	12
2	Cold secondary air duct	m/s	12
3	Hot primary air duct	m/s	25
4	Hot secondary air duct	m/s	25
5	Flue gas duct	m/s	15
6	Seal air duct	m/s	25
7	Pulverized coal pipe	m/s	28

5.4.8.2 Air and flue gas duct wall thickness

The wall thickness of air and flue gas duct is limited herein after;

No	Air and flue gas duct	unit	Min. wall thickness value
1	Cold primary air duct	mm	4
2	Cold secondary air duct	mm	4

3	Hot primary air duct	mm	4
4	Hot secondary air duct	mm	4
5	Flue gas duct before FGD	mm	5
6	Flue gas duct after FGD	mm	6
7	Seal air duct	mm	4
8	Pulverized coal pipe	mm	10

5.4.9 Auxiliary Boiler

The requirements of the steam for starting up of the power station shall be required with the steam of pressure for ~1.3MPa (a) and temperature for 350℃. A LDO-fired packaged auxiliary boiler (1x20t/h) system shall be considered to meet the requirements of starting up of the power station.

5.5 STEAM TURBINE AUXILIARY SYSTEM

5.5.1 Main Steam, Reheat Steam, Turbine Bypass

The main steam piping shall be guided out from superheater outlet header of the boiler, to the two main stop valves separately.

The cold reheat steam piping shall be separately guided out from the two exhausting steam nozzles of the high pressure cylinder, to reheater inlet header.

The hot reheat steam piping shall be guided out from reheater outlet header, to the two IP combined stop valves separately.

The main steam, cold reheats and hot reheat steam system performance design shall be based on turbine valve wide open (VWO) heat balance requirements

Cold reheat steam system shall also provide steam source for No.2 HP heater, and auxiliary steam system. The branches of the cold reheat steam line are connected to No.2 HP heater and auxiliary steam system respectively, as No. 2 extraction steam for No.2 HP heater and standby steam source for auxiliary steam system.

A two stage (HP & LP) turbine bypass system shall be provided to start-up. The bypass system shall be capable to permit the matching of steam and turbine metal temperature during cold start-up, warm start-up, hot start-up and very hot start-up，meanwhile the house load and load rejection condition。

The capacity of turbine HP by-pass system shall be designed according to ~1x60% BMCR with the LP Bypass 2x30%, The HP and LP bypass system shall be hydraulic type. Final bypass capacity shall be finalized during detail design according to more detail data.

HP steam shall be introduced to cold reheat steam pipe after decompressed and attemperated by HP bypass valve from main steam pipe. Attemperating water will come from feed water system.

LP by-pass shall be introduced out from hot reheat steam pipe, and then to exhaust device after decompressed and attemperated. Attemperating water will come from condensate water system.

The main steam, hot and cold reheat steam piping shall be designed with adequate drainage to prevent water entering the turbine according to ASME TDP (latest revision). Drains shall be provided at each low point on the main steam and hot and cold reheat steam lines, each pipe separately to the exhaust device.

Material for this system main pipe shall be as following,
MS and HP bypass valve upstream: A335P91 ASTM/A335
CRH Main pipe: A672B70CL32 ASTM672
CRH Branch pipe and HP bypass valve downstream: A106 B ASTM A106
HRH and LP bypass valve upstream: A335P22 ASTM/A335
LP bypass valve downstream: Q235-B

5.5.2 Turbine Extraction Steam System

The extraction steam system will convey steam from various turbine extraction to the specified heaters and provide heat energy required for heating condensate and feedwater, i. e., heating condensate, and heating feedwater to increase heat efficiency of the whole power plant.

The system will also supply steam to auxiliary steam system as steam source.
The system consists of eight (8) stages of non-adjustable steam (including HP casing exhaust). No.1, No.2 and NO.3 extraction steam provide steam to the three HP heaters.

NO.4 extraction steam provides steam to the deaerator and auxiliary steam system, and to TD-BFP. NO.5, NO.6, NO.7& NO.8 extraction steam provides steam to the other four LP Heaters. The motor operated isolation valve shall locate at the turbine side to prevent water from coming into turbine, as first safe guard. The pneumatic check valve shall locate at the heater side to prevent the turbine from water induction and over speed, as second safe guard. Heater extraction piping isolation/check valves except for the neck heaters shall be located as close as possible to main turbine connections, to limit over speed potential after turbine trip.

5.5.3 Auxiliary Steam System

An auxiliary steam manifold shall be provided for the whole plant. Parameters of the auxiliary steam

manifold will can meet the requirements of each steam utilization point. The system can provide auxiliary steam to various users before unit start-up, during unit start-up and unit in normal operation.

Auxiliary steam shall be introduced to auxiliary steam header from steam source, and be introduced to all users from manifold. Safety valve(s) shall be provided on the auxiliary steam manifold of each unit, so as to protect the system from over pressure that may be caused by a high-pressure system.

The auxiliary steam shall be come from cold reheat steam, No.4 extraction steam and start-up boiler.

The system will supplies the required steam to the followings in any operation condition.

1) To the deaerator during the unit start up, shut down and turbine load rejection or trip.
2) To the gland sealing system during the turbine start up and shut down.
3) For soot blower of air heater
4) To BFP turbine commissioning
5) To another users.

Drainage water from auxiliary steam pipe shall be led to turbine proper drain flash vessel while unit startup and unit normal operating condition.

5.5.4 Feed water System

The Boiler feedwater system will deliver feedwater (condensate) from the deaerator storage tank to the boiler economizer inlet header.

The system shall be equipped with two sets of 50% capacity turbine driven boiler feedwater pump and one 50% capacity motor driven boiler feedwater pump for one unit. The motor driven feedwater pump shall be speed adjustable type. Two turbine driven pumps shall be in operation and the motor driven pump is just for standby and during unit start-up time when load is low.

Three HP heaters are equipped with a common by-pass valve, it has advantage of simple system ,less valve and convenient operation and maintenance and the common bypass can be out of service from the system when anyone of the three HP heaters is at emergency ,and ~30% BMCR flow control valve is used for adjusting the flow during unit start-up .

Boiler feed pumps shall be provided with its minimum flow recirculation valve for returning to the deaerator respectively. A flow nozzle shall be provided for above each pump to allow minimum flow recirculation control, and the nozzle shall be arrangement on the pipe between booster pump outlet and boiler feed pump inlet.

A branch of the BFP outlet pipe will supply the desuperheating spray water to the HP by-pass. The desuperheating spray water to the boiler superheater shall be provided from another branch of BFP outlet pipe. The reheater desuperheating spray water shall be provided from the intermediate bleed connection of the BFP.

Deaerator is designed for the turbine generator on load with control valves wide open and it also can be meet the requirement of sliding pressure operation. The form of deaerator is spary tray type.

The deaerator rated output is not less than 105% of water consumption at BMCR condition, deaerator output range shall be 10% to 110% of the rated output. When one low-pressure heater out of service, the deaerator's output is not less than 90% of its rated output.

Using steam-injection atomized nozzle which has a large quantity output and high heat and mass transfer, increasing deoxidization efficiency. The oxygen in feed water is less than 7μg/l.

Effective capacity of storage tank is not less than 5 minutes storage flow corresponding to VWO. The storage tank water cubage is that between normal water level and the top of the water discharge nozzle.

The boiler feedwater pumps (BFP) deliver feedwater from the deaerator to steam generator economizer inlet header and also supply high pressure water to the reheater and superheater attemperators, as well as high pressure turbine bypass desuperheaters.

The boiler feed water pump capacity should be sum of following:
110% BMCR flow
Reheater desuperheating water flow
Shaft sealing and leaking water for BFP (if applicable)
The BFP total head should be sum of following:
Static pressure difference between deaerator normal water level and economizer inlet
the system total resistance (BMCR water) plus 20% margin from the deaerator outlet to economizer inlet
Economizer inlet pressure
Deaerator rated pressure (negative value)

Pump flow curve should be without the hump in stable operation curve, from the rated flow to zero flow of the head should be stable rising, its head rising value shall not exceed 30% of the rated flow head. Minimum flow of the pump shall not be more than 25% of the rated flow, pump group does not establish a warm pump system, cold start can be realized to full load. The first critical speed pump should be no

less than 125% of the maximum working speed.

Material for HP feed water shall be 15NiCuMoNb5-6-4 EIN10216-2.

5.5.5 Condensate System

The condensate system will remove condensate from the exhaust device to two inlets of two condensate pumps. After the condensate pumps, the condensate shall be delivered to the deaerator storage tank through an IP condensate polishing device, a gland steam condenser and LP heaters. During this process the condensate shall be heated, deaerated, chemically treated and cleansed of impurities.

The system will incorporate 2x100% capacity constant speed electric motor driven vertical condensate pumps, one in operation and one for stand-by. One set of full flow IP condensate polishing system and its bypass shall be furnished.

A set of control valves shall be adopted on main condensate piping to adjust deaerator water level.

Two (2) 100% constant speed condensate pumps, single suction , vertical can type, multi-stages centrifugal design, are used to deliver condensate water. One is operating and one is standby under normal operating condition.

Condensate extraction pump capacity shall be the maximum condition condensate flow , that is 110% of the total amount of the water below:

1. Steam condensing flow under VWO condition
2. Normal drain flow into condensate system
3. Normal make-up flow into condensate system
4. Other miscellaneous water

The condensate extraction pump head should be sum of following:

1. Condensate static pressure difference
2. The deaerator maximum work pressure
3. Condenser highest vacuum
4. Condensate system equipment resistance
5. The condensate system pipeline resistance (plus 20% margin)

In various conditions shall keep the condensate pump cavitation don't happen. Pump inlet mesh (its resistance should be less than 0.03 MPa) designed to be removable type, the minimum flow of the pump shall not exceed 25% of the normal flow, the water pump rotor first critical speed should be no less than 125% of the working speed. The head of the condensate pump flow with the performance curve (Q-H curve) shall be gently, and from the rated flow to zero flow of the increased value of head

not more than 20% of the head under the rated flow.

5.5.6 Heater Drains and Vents System

Heater drain and vent system will reclaim extraction steam condensate from boiler feedwater heaters and vent non-condensable gases from boiler feedwater heaters. This will provide supplemental feedwater heating by cascading drains from higher pressure to lower and provide the provisions for preventing main turbine from water damage.

The normal drain line and the emergency drain line shall be equipped for each heater. During normal operating conditions, heater drains will cascade from higher to lower pressure heaters by means of self-flowing, HP heater drains shall be finally leads into the deaerator, and LP heater drains shall be finally lead into the exhaust device.

During unit startup or operating conditions where the normal cascade drain path is not available or its flow capability diminished due to low system operating pressure, an alternate drain path (emergency drain) shall be furnished for each heater. The emergency drain from high pressure heaters shall be discharged into HP heater emergency drain flash vessel. The emergency drain from low pressure heaters shall be direct discharged into the exhaust device or proper drain flash vessel.

The condensate level of HP/LP heaters shall be controlled by the heater drain control valve.

The deaerator water tank shall be provided with piping to exhaust device or proper drain flash vessel for overflow or discharge.

The vent and drain connections shall be provided at the water side and shell side of each heater, and the overpressure protection device shall be also provided. Besides, each heater shall be furnished with continuous vents which connected to the deaerator or exhaust device to remove non-condensable gases.

5.5.7 Air Evacuation System

There are two 100% capacity mechanical vacuum pump in vacuum system, when unit start-up, three vacuum pumps put into operation to speed up the process of vacuum. During normal operation, one work , one stand-by. In the exhaust steam within the device to establish and maintain vacuum. In emergency trip, break condenser vacuum,。

5.5.8 Opened Cycle Cooling Water & Closed Cycle Cooling Water System

Auxiliary equipments 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 dematerialized water.

The closed cycle cooling water system will comprises of two 100% cooling water pumps (one working and one standby), two 100% dematerialized water/circulating water plate heat exchangers, one expansion water tank with $5m^3$ capacity. Expansion water tank will located on deaerator floor, ~22mEL., 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 opened cycle cooling water system will comprises of two 100% cooling water pumps (one working and one standby), and one auto motorized filters. Manual chemical dosing provisions are included for the closed cycle cooling loop."

5.5.9 Circulating water system

The main function of the circulating water system will be to provide a continuous supply of cooling water to the main condenser, so as to extract the heat of condensation of exhaust steam from the main turbine and to maintain the main condenser under high vacuum over the whole range of unit operating loads.

The water for the open cycle cooling water system will be taken from the circulating water system, and will be used for cooling CCCW heat exchangers and mechanical vacuum pump coolers and turbine lube oil cooler;

This part of circulating water system will only include the condenser inlet and outlet piping, isolating or butterfly valves, expansion joints and complete set of on-line condenser tube cleaning system, etc.

5.5.10 Main Building Arrangement

The main building arrangement with equal column spacing according to the following sequence: turbine hall, deaerator bay, coal bunker bay, boiler property, ESP, I.D fans, stack, and FGD.

Turbine shall be installed indoor; the turbine/generator unit shall be longitudinal arranged in line. The operating floor level shall be 12.60m.

One set of crane (capacity 75t/20t) shall be provided for the turbine house for one (1) unit. The capacity of crane shall be selected in accordance with the heaviest component which shall be lifted during normal maintenance work (not including lifting of generator stator).

Boiler shall be outdoor type. The top of boiler shall be covered with canopy.

5.6 COAL HANDLING SYSTEM

5.6.1 General

The coal handling system is designed for one (1) unit. The design scope of coal handling system in the

plant covers whole technology process that is from belt-conveyor transporting and truck unloading to coal bunkers, including coal unloading, storage, screening, coal crushing, transporting, iron separating, measuring, sampling and so on.

Coal handling system shall consist of:
-Coal transferring into plant from outside.
-Coal storage yard, stacking/reclaiming equipment.
-Screening and crushing system.
-The conveying and handling of coal from coal storage yard to coal bunker bay
-Equipment for coal distribution on coal bunkers.
-Any required coal process including removal of ferrous tramp material, weighing and sampling, etc.
-Auxiliary systems such as programmable control, water spray & dust suppression, dust collection, ventilation, water sluicing, communication and fire fighting system shall be provided in coal handling system.

5.6.2 Coal Supplying

a) Coal Supplying

The coal shall be sourced potentially from Coal-Washing Plant nearby invested by Contractor with a distance of 1000m.In alternative; coal shall be directly supplied from coal mine nearby by truck in case Coal-Washing Plant breaks down.

The trucks will be of self-unloading type .It's suggested that the power plant itself has no need to prepare trucks and drivers, which can be hired in other transport company. Coal will be transferred from The Salt Range to the plant via roads like Katha-Lilla Rd,Lilla-P.D.Khan Rd,P.D.Khan-Mandi Bahuiddin Rd. The distance will be no more than 50km.

b) Coal Consumption

Coal consumption refers to section 3.3.

5.6.3 Coal Unloading Facility

About 1,215,000 tons coal shall be transported from Coal-Washing Plant by belt-conveyor yearly. The design interface for Power Plant and Cola-Washing Plant shall be the exit of coal chute in Transport Tower of Coal-Washing Plant. The belt conveyor shall be single stream, with rated capacity of 300t/h, width of 800mm and speed of 2.0m/s, The conveyor gallery is open with any enclose, there is only cover on the conveyor belt.

About additional 364,500 tons coal, 30% of total yearly consumption shall be transported from coal mine nearby by the self-unloading type trucks yearly. It is suggested to construct two emergence

underground coal hoppers for truck unloading.

5.6.4 Coal Storage Yard and Facilities

The storage capacity of coal yard shall be 180,000 tons, about 45day's performance coal consumption for one unit in BMCR condition. One bucket wheel stacker / reclaimer shall be equipped for stacking and reclaiming. The stacking capacity shall be 300t/h, and the reclaiming capacity shall be 300t/h, with turning radius of 30m and coal pile height of 13.5m.

Dry coal shed shall be constructed above the coal yard according to local climate, which will contain about 40,000 tons dry coal, meeting consumption need of one (1) unit for 10 days.

Two bulldozers and one wheel loaders shall be applied for heaping and compaction work. Two emergency underground coal hoppers will also substitute if bucket wheel stacker / reclaimer breaks down. Wind resistance wall shall be applied around coal yard. One belt conveyor shall be equipped in coal storage yard and one below the hoppers. All conveyors shall be single stream, with width of 800mm, speed of 2.0m/s, and capacity of 300t/h.

5.6.5 Screening and Crushing Facilities

Coal screening and crushing system shall be arranged with two streams, one operation, and the other one standby.

Two (2) roller screens shall be provided, with capacity rated of 300t/h. Two (2) ring crushers shall be designed for crushing the coal, with capacity rated of 250t/h. The output particle size shall be (-) 30mm.

5.6.6 Belt conveying System

The belt conveyors from Coal-washing Plant to coal yard shall be single stream, and from coal yard to coal bunkers shall be dual stream, all with width of 800mm, speed of 2.0m/s and rated capacity of 300t/h.

The conveyor galleries shall be open, with sidewalk made of steel grate and hood covers over the belts. The tilt angle for galleries shall be no more than 16°.The net width shall be 6000mm.

Electric driven two side plough unloaders shall be used in bunker bay to distribute coal to the coal bin.

5.6.7 Auxiliary Equipments

All auxiliary equipments for a complete and operable system shall be provided.

1) Magnetic Separators

In order to guarantee the smoothly operation of coal handling system, Magnetic separators shall be

provided.

2) Belt Scales

One belt scale and check chain calibrator shall be provided for weighing coal transferred into the Plant, and two for weighing coal transferred into the boilers.

3) Coal Sampling Devices

One as-received sampling device shall be equipped on the truck transporting route, and one on the belt conveyor from Coal-washing Plant.

As-fired coal sampling devices shall be provided on the belt conveyors to the main building.

4) Protection Devices

Protection devices such as cord switch, belt deviation switch, slipping detector, stream signal etc, shall be provided for belt conveyors.

5) Maintenance and Hoisting Equipments

The hoisting equipments in the system (such as crane, electric hoist) shall be installed at the points suitably:

- Transfer towers
- Crusher house
- Bunker bay

6) Truck scale

Truck scales shall be provided for weighing the coal transported into plant, with one set of 100 tons loading truck weigher and one set of 50 tons empty truck weigher.

7) Coal chute

The tilt angle for coal chute shall be no less than 60°.

5.6.8 Dust Control

The dust collections shall be provided in the transfer points. The galleries and the transfer towers shall be equipped with water washing down system. The sump pits shall be designed in the transfer towers.

Sprayers shall be mounted around the coal yard in order to decrease the dust pollution.

5.6.9 System Control

The complete coal handling system shall be potentially operated from control room with a integrated PLC control system. The equipments that controlled by the program can either remote control or local

control. Some important points in the system shall be equipped with the pickup camera in order to get the state of the equipments.

The coal handling system shall be controlled in the coal handling system complex building

5.6.10 Auxiliary Building

Coal handling system complex building shall be provided. There shall be offices, bath rooms and the central control room in the building. Bulldozer shed shall be provided too, which includes three parking space and one maintenance space.

5.7 ASH HANDLING SYSTEM

5.7.1 The quantity of ash

The ash handling system has been designed according to the following design data (These date are calculated from the assumed coal quality data provided by boiler professional).

Actual ash amount is listed as follows:

Ash amount Boiler number	Quantity per hour(t/h)			Quantity per day(t/d)			Quantity per year($x10^4$t/y)		
	Fly ash	Bottom ash	total	Fly ash	Bottom ash	Total	Fly ash	Bottom ash	total
Design Coal	44.41	4.94	49.35	1065.84	118.56	1184.4	33.01	3.68	36.69
Check Coal	54.30	6.04	60.34	1303.2	144.96	1448.16	40.43	4.50	44.93

Notes:

- Quantity per day is calculated for 24 hours every day.
- Quantity per year is calculated for 7446 hours (average value in five years. Allowances shall be granted in the PPA for first year after COD and major maintenance year during operation.)
- The ratio of fly ash to bottom ash is 90:10.
- The quantity of pyrites is 0.82t/h for design coal, and 0.86t/h for check coal for one boiler.

5.7.2 System Function and Constitution

The function of the Ash Handling System is to collect, store and transport solid wastes resulting from the combustion of coal in the boiler. Solid waste products are bottom ash from boiler furnace, fly ash from the hoppers of the ESP and the economizer, and Pyrites from mills.

Ash Disposal System consists of three entirely independent systems: Mechanical type Removal of Bottom Ash System, Mechanical type removal of Pyrites System, and Dry-type Removal of Fly Ash system.

(1) Bottom Ash handling System Function

Collecting bottom ash from bottom ash hopper.

Cooling bottom ash in Submerged Scraper Conveyor (SSC).

Conveying bottom ash to bottom ash bin by SSC.

Transporting bottom ash to ash disposal yard by trucks.

(2) Pyrites Handling System Function

Collecting pyrites into the pyrites hoppers from mills.

The pyrites hoppers shall be carried to stack area outside of the boiler room by a forklift.

Transporting pyrites to ash yard by trucks.

(3) Fly Ash Handling System Function

Collecting fly ash from the hoppers of the ESP and the economizer.

Conveying pneumatically fly ash to fly ash storage silos.

Storing fly ash in fly ash storage silos.

Mixing ash in slurry for transportation to ash yard by trucks.

5.7.3 Bottom Ash handling System

Bottom ash discharged from boiler shall be collected in Submerged Scraper Conveyor (SSC) and cooled & grained, then discharged to bottom ash bin. One (1) adjusted speed SSC shall be provided for one boiler. The maximum capacity of SSC shall be more than 400% bottom ash amount when burning performance coal at BMCR. The output of SSC shall be 5t per hour to 25t per hour during normal operation. The bottom ash bin shall be steel cylinder construction with suitably sloped conical outlet. Bottom ash bin shall have effective capacity of 115 m3 to store 20.9 hours bottom ash quantity when burning design coal. From the bottom ash bin outlet the semi–dry bottom ash shall be unloaded to open trucks.

Under normal operation, the temperature of cooling water in SSC is increased to an equilibrium temperature, Bottom ash cooling is mainly through the evaporation of water, and the heat of vaporization of water to absorb heat, no overflow water discharge.

The water from dewatering element of bottom ash bin conical part and the flushing water for the ground of bottom ash bin shall be collected in sludge sump and then pumped back to SSC by two (2) sludge pumps (one working and one standby) for one boiler.

5.7.4 Pyrites Handling System

Mechanical pyrites handling system shall be adopted. Six (6) removable e pyrites hoppers with level indicaters shall be provided for each unit. The pyrites discharged from mill will fall into the removable pyrites hopper which is installed beside the mill; the hopper shall be connected to mill outlet with a pneumatic gate. Normally the pneumatic gate above the hopper keep open, pyrites fall into the pyrites hopper, when the hopper is full and need to discharge, close the gate above the hopper, the removable

pyrites hopper shall be carried to stack area outside of the boiler room by a forklift, the pyrites can be transported to ash disposal area by truck.

5.7.5 Fly ash handling system

The Fly Ash handling system will adopt the positive pressure pneumatic conveying system. One (1) set pneumatic conveying system shall be provided for conveying ESP ash and economizer ash of one boiler. The output of the system shall be not less than 150% of ash amount when burning the design coal and not less than 120% of ash amount when burning the check coal. The normal capacity of the system is 75t/h.

One (1) fly ash transmitter shall be installed under each hopper outlet of ESP and economizer ash hopper. Fly ash collected in ESP ash hoppers and economizer hoppers will fill into fly ash transmitter through open inlet valve then be conveyed by compressed air through ash pipe to fly ash silos and stored in them. Total two (2) fly ash pipes for ESP and economizer shall be provided for one boiler, two (2) fly ash pipes can be connected to either fly ash silo through switchover ash valve on the top of fly ash silos. Ash pipe shall be thicker steel pipe and elbow of ash pipe shall be wearable. Two (2) concrete cylinder shape fly ash silos shall be provided for one boiler, the fly ash silos can store 27 hours fly ash with design coal. Two (2) outlets shall be provided for bottom of each fly ash silo. One (1) dust conditioner for unloading semi–dry ash with 15%~25% water content to open truck and one (1) dry ash unloader for unloading dry ash to closed truck are supplied for each ash silo. All of unloading equipment shall be located on the 6m operating floor of silo.

A vent filter shall be installed on the top of each fly ash silo, and the air in the silo will pass through the filter and discharge to the atmosphere. A safety release valve shall be installed on the top of the each silo for the fly ash silo safety operation. For ash fluidity in the silos, and guarantee smooth and uniform unloading ash, three (3) fluidizing blowers for fly ash silos (two working and one standby) shall be provided for two silos. The fluidizing air shall be heated to 150 ℃ by air heater then be conveyed into chutes of ash silos. One (1) operator room shall be located at the 2.8m floor of each silo. The local control console shall be installed in it. The access road shall be located at 0m of each silo.

The conveying air compressor system shall be commonly consisted of fly ash conveying system and I&C air system for the whole plant, Total five (5) conveying air compressors shall be provided for two boilers, three (3) working (two (2) for ash conveying system and one (1) for I&C system), and two (2) common standby.

5.7.6 Ash utilization

Big yard will be taken up and the environment will be damaged by the ash from the power plants. The comprehensive utilization of ash can solve the two problems, and also conform to the state of the newly built or renovated the plant's energy policy, and meet the relevant provisions of the local of ash

handling.

Physical and chemical properties of ash determine its wide range of uses. Such as bottom ash can be used as embankment filling, pavement base materials, packing and cement concrete pavement of asphalt concrete admixture; Fly ash from ESP can be used as good admixture for damming and building highway, the concrete cost can be reduced and performance can be improved when it mixed with certain proportion of dry ash. Fine grinding fly ash can be used as the cement aggregate or used directly mixed with cement. Fly ash used as the lightweight building block, is a kind of very good building materials with heat preservation, heat insulation and sound absorption characteristics。 In addition, the fly ash containing a variety of trace elements that crops need, so can also be used to improve farmland soil and prevent soil harden and so on。

Desulphurization gypsum，by-product of limestone-gypsum wet flue gas desulphurization has widely utilization way, such as cement, building materials industry, construction and agriculture, especially in the new building materials, it occupies a special place.

Gypsum as cement admixture, has retarding action, the dosage general for 3 ~ 5%. At present, the cement admixture most from the natural gypsum mine, takes a lot of the country resources. It is no major technical renovation, and easy implement that the desulfurization gypsum used to instead of natural gypsum. The main harmful impurity content should be controlled in desulfurization gypsum, and the desulfurization gypsum surface moisture should be sharply decrease, or the gypsum granulation plant should be adapt to the cement technological requirements. Thus the cement industry and construction industry will become a huge market to boost the comprehensive utilization of desulfurization gypsum.

5.7.7 Ash Handling Control System

The control system can provide three modes of operation: automatic, remote manual and local manual. Operation mode can be optional. The automatic sequence control is the essential mode operation. The operator can select a graphic display of equipment state on LCD on mimic screen in the control room. The interlocking program can assure to start or stop the equipment in sequence specified by processing. In manual remote control, the control system can make the equipment interlock and the operator be able to control manually the system in the control room. The local testing mode can start or stop the equipment locally under non-interlock. The operating station is located in the control room. The operator can supervise system operation state, inputting the order by means of keyboard. LCD can display the graphics of system diagram, system state and equipment parameters, to guide the actions for the operator.

The detail information is shown in the drawing No. 60-F1404K-C01-01 to 03.

5.8 WATER SUPPLY SYSTEM

5.8.1 Water Demand and Water Source

The total Annual Average Makeup Water Flow for power plant shall be 794m^3/h, total Summer Makeup Water Flow is 864m^3/h. Ground water lifted by deep well pumps from JHELUM River northern shore shall be used as water source for this project.

5.8.2 Makeup Water System Outside

Each deep well pump shall be installed in a Deep Well Pump House.

Due to the Ground Water survey work unfinished, the locations\single well flow and depth is incertitude for now,

According to Preliminary Report for Ground Water Assessment and Hydrological Studies, sweet water aquifer(s) are mainly located along the River Jhelum. While the option of shallow underground sweet water is adopted, more deep wells and rented land area will be required, While the option of deep underground salty water is adopted, less deep wells and rented land area will be required, additional water desalting system in the plant shall be equipped.

On current state, shallow underground sweet water is decommendated.

According to Preliminary Report for Ground Water Assessment and Hydrological Studies, each deep well pump design flow shall be assumed as 50m^3/h, and each deep well pump total discharge head shall be assumed as 50m. The ground water shall be delivered to plant by Two (2) PE Pipes with a size of DN300mm. The makeup pipelines distance about 5km, and when deep well pumps location be confirmed later, the Pipeline distance will revised.

Width of aquifer(s) range from negligible shall be more than 2km.

The site selected for installing tube wells is around 750m wide and estimated length may be around 14 km; and each deep well pump design flow shall be assumed as 50m3/h.

19 Deep Well Pump House shall de designed.

The ground water shall be delivered to plant by Two (2) PE Pipes with a size of DN300mm. The makeup pipelines distance about 5km, and when deep well pumps location be confirmed later, the Pipeline distance will revised.

5.8.3 Cooling Water (CW) System

5.8.3.1 System Description

Recycle Circulating Water system with counter flow Natural Draft Cooling Tower would be adopted.

The unit shall be equipped with one (1) natural draft cooling tower, 2X50% capacity vertical wet well type circulating water pumps. Circulating water pumps shall be installed in CW Pump House adjacent to Cooling Tower, and One (1) Pressure CW Inlet Piping (DN2400mm) from CW pump House to Turbine building, One (1) Pressure main Outlet Piping (DN2400mm) from Turbine building to Cooling Tower and a Reinforce Concrete Trench from Cooling Tower to CW Pump House. Inlet and outlet piping near Turbine building of Condensate is DN1800mm.

The cooling water consumptions of the plant units are showed in the table below.

Unit (MW)	Condensate Exhaust Steam flow（t/h）	Cooling water (m^3/h)		
		Cooling water for condenser	Cooling water for Auxiliary water equipment (m^3/h)	total Cooling water flow (m^3/h)
1×330	~1×620	~37200	~2035	~39235

Notes:

- Condensate steam is under TRL working condition
- Cooling rate is 60.

5.8.3.2 CW Pump House

A CW Pump House shall be installed for this project. In this CW Pump House, two (2) 50% CW Pumps, two (2) 50% Trash Cleaner & Bar Screen shall be installed.

Two (2) independent inlet channels shall be arranged for the two (2) 50% CW Pumps. On inlet channels, two (2) 50% Trash Cleaner & Bar Screen shall be arranged.

The CW Pump House shall be without envelope except an overhead shading, under the shading one (1) electric hoist (T=32/5t) and one(1) electric hoist (T=10t) shall be installed for maintain CW pumps and butterfly valves.

For the general arrangement and section of the CW Pump House, refer to the DWG. No. F1404K-S01-03 and F1404K-S01-04.

5.8.3.3 CW Pump

Two (2x) 50% CW Pumps shall be installed in the CW Pump House, to provide a continuous supply of cooling water for the ST Condensers and ACW system Heat Exchangers. On the discharge pipe of each CW Pump, one (1) two-stage close type Hydraulically-controlled Butterfly Valve with a size of DN1800mm shall be arranged.

Main design parameters of each CW Pumps are as follows:

Type: vertical mixed flow type

Capacity: 5.45m^3/s

Head: 24m

Power: 1800kW

5.8.3.4 Trash Cleaner & Bar Screen

Two (2) 50% Trash Cleaner & Bar Screen shall be arranged on each independent inlet channel of the CW Pumps House, to hold and remove suspended solids in the cooling water. Main design parameters of each Travelling Screen are as follows:

Nominal width: 4m

Nominal depth: 8m

5.8.3.5 Sump Pumps

Two (2) x100% Sump Pumps shall be installed in the valve pit in the CW Pumps House, to discharge water collected in the Sump Pit to outside.

Main design parameters of each Sump Pumps are as follows:

Type: vertical long shaft pump

Capacity: 10m^3/h

Head: 14m

Power: 1.1kW

5.8.3.6 Cooling Water Pipe

One (1) FRP Cooling Water Supply main Pipe (from the CW Pump House to the Steam Turbine House) and one (1) FRP Cooling Water Return main Pipe (from the Steam Turbine House to the Siphon Pit), with a size of DN2400mm each, shall be provided for the CW system and the pipes shall be arranged to be buried underground.

5.8.3.7 Natural Draft Cooling Tower

A Natural Draft Cooling Tower shall be adopted in CW system. Total cooling tower spray area is about 6000m^2.

The design meteorological conditions are as following:

Dry bulb temperature	31.8℃
Barometric pressure	969.1hpa
Relative humidity	70.4%

The tower outlet water temperature not more than 32℃under above meteorological parameter, the final cooling tower spray area shall be confirmed according to latest meteorological parameter.

The water in cooling tower basin flows into the CW Pump House forebay by a drainage ditch. And four

(4) Bar Screens shall be installed at the inlet ditch.

5.8.4 Make-up Water System inside

According the water quality analysis at present, the well water shall be used for service water, chemical water, cooling tower make-up water, fire-fighting water directly.

The well water shall be stored in two steel Service Water & Fire Water Tanks and Potable Water Tank, the total Service Water & Fire Water Tanks capacity is 2x2000m^3, the Potable Water Tanks capacity is 100m^3.

The deep well water shall be piped to Service Water & Fire Water Tanks and Cooling Tower Basins directly. The service water, chemical water shall be pumped by Service Pumps, DM Makeup Pumps, the pumps will intake water from Service Water & Fire Water Tanks. The potable water pumps will lift water to the sanitary wares in the plant.

For flow diagram of the water supply system, refer to the DWG. No. F1404K-S01-02.

The water treatment process shall be adjusted according to the final well water quality analysis.

5.8.4.1 Service Water System

Main function of this system is to supply service water throughout the Power Plant for floor-flushing, cooling and cleaning of equipments and so on with sufficient pressure and flow rate.

2X100% Service Water Pumps shall be provided for this power plant, installed in Comprehensive Water Pump House. By the Service Water Pumps, the service water shall be delivered through the service water distribution pipeline to the service water-using points throughout the Power Plant.

Main design parameters of the Service Water Pumps are as follows:

Capacity: 150~350m^3/h

Head: 65m

Power: 110kW

The service water shall be delivered by PE Pipes with a size of DN200mm.

5.8.4.2 Chemical Water System

Main function of the system is to supply water to Boiler Make-Up Water Treatment Plant with sufficient pressure and flow rate.

2X100% Chemical Water Pumps shall be provided installed in Comprehensive Water Pump House. By Chemical Water Pumps, the water shall be delivered to Boiler Make-Up Water Treatment Plant.

Main design parameters of the Chemical Water Pumps are as follows:

Capacity: $50m^3/h$

Head: 30m

Power: 12kw

The service water shall be delivered by PE Pipes with a size of DN150mm.

5.8.4.3 Potable Water System

Main function of this system is to supply potable water to the potable water-using points throughout the Power Plant with sufficient pressure and flow rate.

One (1) set of Potable Water Supply Equipment shall be provided for this power plant, installed in Comprehensive Water Pump House. The Potable Water Supply Equipment is comprised of 3x50% Variable Frequency Pumps and one pressure-stabilization Tank. By the Potable Water Supply Equipment, the Potable water shall be delivered through the Potable water distribution pipeline to the Potable water-using points throughout the Power Plant.

Main design parameters of the Potable Water Supply Equipment are as follows:

(a) Potable Water Pumps (variable-frequency)

Capacity: $30\sim80m^3/h$

Head: 65m

Power: 32kw

(b) Pressure-stabilization Tank

Effective volume: 1400L

The portable water shall be delivered by HDPE Pipes with a size of DN150mm.

5.8.5 Drainage Pipeline System

Industry Wastewater pipeline system (including Oily Wastewater pipeline system), Sanitary Sewage pipeline system and Rainwater pipeline System shall be applied in plant. RCP (reinforced concrete pipes) shall be adopt to all of the Drainage pipeline systems inside plant.

The Cooling tower blowdown water shall be reused to Ash Handle system and Coal Handle system, affluent shall be discharged to JHELUM river Southern about 6km. When Plant Drainage Point is confirmed, the outside Drainage Pipeline distance will revised later.

5.8.6 Boiler Make-Up Treatment System

The main function of Boiler Make-Up Treatment System is to supply water to Boiler Make-Up Treatment Plant.

Boiler Make-Up Treatment System water shall be stored in the 2x2000m³ raw water reservoir, and then delivered to the plant consumers by Boiler Make-Up Treatment System water pumps.

5.9 CHEMICAL WATER TREATMENT

Chemical part will consist of the following sub-systems,

1) Demineralized Water Treatment System
2) Condensate Polishing System
3) Chemical Dosing System
4) Steam and Water Analysis System
5) Circulating cooling water treatment System
6) Hydrogen Generation System
7) Waste Water Treatment System
8) Chemical Laboratory Equipment

5.9.1 Demineralized Water Treatment System

In this project, the underground water shall be used the plant industrial water, The water quality for design reference is following:

No.	Parameters	unit	Analysed Result	Analysed Result	Analysed Result	Analysed Result
1	pH	/	7.5	7.3	7.07	7.05
2	Conductivity at 25℃	μs/cm	631.4	3967.3	926.5	763.9
3	Total hardness as $CaCO_3$	ppm	387.1	1129.3	474.0	305.0
4	Turbidity	NTU	<1.0	<1.0	<5.0	<5.0
5	Suspended matter	ppm	2.2	No detected	18.2	20.0

According to "code for designing chemistry of power plant" (GB 5068-2006), the ground water is used to the plant industrial water ,the four papers of raw water quality in one year for each quarter must be supplied..so in the next stage, please offer the raw water quality for checking the water treatment system.

5.9.1.1 Water-steam Quality Standard

According to "Quality criterion of water and steam for generating unit and steam power equipment" （GB/T 12145-2008）,the water-steam quality should meet the requirements bellow:

A. Quality standard for boiler feed water:

Dissolved oxygen: ≤7μg/L

Fe: ≤20μg/L

Cu: ≤5μg/L

pH: 9.2～9.6

TOC: ≤500μg/L

N_2H_4: ≤30μg/L

Conductivity: ≤0.30μs/cm (25℃, after H^+ exchanger)

B. Quality standard for steam:

Na: ≤5μg/kg

SiO_2: ≤20μg/kg

Fe: ≤15μg/kg

Cu: ≤3μg/kg

Conductivity: ≤0.15μs/cm (25℃, after H+ exchanger)

C. Quality standard for boiler water:

PO^-_4: ≤3 mg/L;

Conductivity: ≤35μs/cm (25℃)

SiO_2: ≤0.45mg/L;

CL^-: ≤1.5mg/L;

PH: 9.0-9.7;

D. Quality standard for boiler make-up water:

TOC: ≤400μg/L

SiO_2:≤20μg /L

Conductivity: ≤0.40μs/cm; (25℃)

5.9.1.2 System functions

①. Supply high purity boiler make-up water for boiler.

②. Supply high purity water to system in power plant operation such as chemical laboratories, closed cycle cooling water system and other places where high purity water is required.

③. Supply necessary high purity water for the cleaning and flushing of boiler and turbine system and filling of the system before start-up.

5.9.1.3 System flow as follows:

The well Water→fine sand filter→filter water tank→filter water pump→RO system→fresh water tank→fresh water pump→Cation Exchanger→decarbonator→intermedia water tank→intermedia water pump→Anion Exchanger→Mixed Ion Exchanger→Demineralized Water Tank→Demineralized Water Pump→main building

5.9.1.4 System capacity and equipment selection

Demineralized water capacity shall be 2x40m^3/h. Including raw water pre-desalination and ion exchange system.

The main equipments of boiler make-up water treatment system shall be two (2) sets RO system , each set can produce 40m3/h and (2) sets of Φ2000mm Cation Exchangers, two (2) sets of Φ2000mm Anion Exchangers, two (2) sets of Φ1400mm Mixed Ion Exchangers and two (2) sets of 1500 m3 Demineralized Water Tanks.

The boiler make up water treatment system drawing please refer to F1404K-H01-01.

The boiler make up water treatment equipment layout drawing please refer to F1404K-H01-06.

5.9.2 Condensate Polishing System (CPS)

5.9.2.1 System functions

①. Treating condensate water with capacity of 100% condensate flow at normal and peak operating conditions, the system will have a 0-100% by-pass line of the maximum condensate flow.

②. To remove trace amount of silica, copper, iron and soluble electrolytes from the condensate during normal operation of the unit.

③. To protect the feed-water and condensate system from pollution. due to leakage of condenser.

5.9.2.2 System description and equipment selection

The Polisher shall be of the rapid flow, mixed bed ion exchange type. The regeneration of the ion exchange resins shall be done in vessels external of the Polishing service vessels. The ion exchange resins shall be separated after removal from the Polishing service vessels, the cation resins shall be regenerated using hydrochloric acid, and the anion resins regenerated using caustic (sodium hydroxide).

2x50% capacity mix-bed Polisher shall be provided; one external regeneration system shall be provided.

The condensate polishing system drawing refers to F1404K-H01-02.

The mixed bed layout in the main plant building and the external regeneration equipments will arranged in DM water plant. Please refer to F1404K-H01-06

5.9.3 Chemical Dosing System (CDS)

5.9.3.1 System functions

The CDS shall be provided to control chemistry of steam cycle and closed cycle cooling water system in permissible levels during operation and in downtime.

5.9.3.2 System description and equipment selection

The CDS shall be consisting of the following sub-systems:

①. Ammonia dosing system

Ammonia dosing system include two (2) ammonia solution tanks, two (2) metering pumps for condensate water, two (2) metering pumps for feed water, together with control cabinets.

② Hydrazine dosing system

Hydrazine dosing system include two (2) Hydrazine solution tanks, two (2) metering pumps for condensate water, two (2) metering pumps for feed water, two (2) metering pumps for closed circulating cooling water , together with control cabinets.

③ Phosphate dosing system

Phosphate dosing system include two (2) Phosphate solution tanks, two (2) metering pumps for boiler drum water, together with control cabinets.

Ammonia and hydrazine dosing point of feed water shall be at deaerator downcomer. Ammonia and hydrazine dosing point of condensate water shall be located at main pipe of the outlet condensate Polishing. hydrazine dosing point of closed circulating cooling water shall be at pump outlet pipe. Phosphate dosing point of boiler water shall be in boiler drum.

5.9.4 Steam and Water Analysis System

5.9.4.1 System Function

①.Provide representative samples for monitoring the operation of the system and equipment.

②. Providing Samples for special laboratory tests.

③. Based on sample analysis data, provide signals to control the chemical injection system.

④ Provide representative samples for monitoring the condensate water

5.9.4.2 System description

One centralized water & steam sampling device shall be provided. Sampling device shall be divided into high pressure & high temperature rack, low pressure & low temperature rack and condenser leakage detection device. After being reduced temperature and pressure in high pressure & high temperature rack, sample water shall be sent to low pressure & low temperature rack, which includes mechanical chiller, instruments and manual sampling device.

One centralized condensate water sampling device shall be provided which includes one (1) condensate water tank, two (2) sampling pumps and instruments rack. The instruments rack shall be arranged in the vicinity of condenser.

The cooling water shall be taken from closed cycle cooling water.

5.9.5 Circulating cooling water treatment System

5.9.5.1 System Function

① To arrest biological growth in Circulating Cooling water system.

② To provent scalling in Circulating Cooling water system

5.9.5.2 System description

The circulating cooling water treatment System comprised with corrosion inhibitor dosing system, sulfuric acid dosing system and electro-chlorination plant.

1 package inhibitor dosing device includes two (2) metering tanks, two (2) metering pumps for Circulating Cooling water system.

1 package sulfuric acid device includes two (2) tanks, two (2) metering pumps for circulating cooling water treatment System.

1 package device of electro-chlorination from salt water includes two (2) sets of 25kg/h sodium hypochlorite generators, two (2) sets of 50 m^3 sodium hypochlorite storage tanks and three (3) sodium hypochlorite solution pumps.

The circulating cooling water treatment building shall be located near the circulating water pump house.

5.9.6 Hydrogen Generation System

2x5 Nm^3/h medium-pressure water electro-hydrogen generation units shall be provided for this project. After being separated and washed in electrolyses, the hydrogen goes into a drying unit and then into hydrogen storage tanks for use.

Three (3) H_2 storage tanks (13.9m^3) and one compressed air storage tank (7m^3) shall be provided.

The hydrogen shall be transferred from the hydrogen storage tanks to the main building by FRP pipe.

5.9.7 Waste Water Treatment System

5.9.7.1 System Functions

The Wastewater Treatment System shall be designed to collect and process the wastewater to meet the criterion of waste water reused or discharge. In this project

5.9.7.2 Waste sources

Waste water from boiler make up water treatment system.

Regeneration waste water from condensate polishing system

Drains from the start up of the unit

Boiler chemical cleaning wastes

Air preheater cleaning wastes precipitator sluicing wastes

5.9.7.3 Operation Description

Regeneration waste water from boiler make up water treatment system and condensate polishing system shall be collected to neutralized pond, after regulating pH to meet requirement to reuse

Boiler chemical cleaning waste water will first be collected in the acid cleaning waste water pool. Then charge to meet the requirement recycle or discharge. There are 3 chemical cleaning waste water ponds; each of the volume is 1000m^3. In this project, the chemical cleaning waste water ponds will share with the rainwater regulation pool.

5.9.8 Chemical Laboratory Equipment

The project in accordance with 330MW unit will provide chemical laboratory equipment.

5.10 Wastewater Drainage and Treatment System

This system includes Industry Wastewater system, Sanitary Sewage system and Coal-polluted Wastewater System.

The treated Industry Wastewater and Sanitary Sewage shall be reused to cooling tower basin; the treated Coal-polluted Wastewater shall be reused to Coal Handle system for spray water.

5.10.1 Industry Wastewater system

This system is designed to collect and treat a variety of Industry wastewater which is produced in the course of daily life and production activities around the Turbine House, Fuel-oil storage area, etc. By the independent drain pipe the wastewater shall be delivered by gravity to the Industry Wastewater Regulation Basin which arranged under the Industrial Wastewater Treatment House.

In the Industrial Wastewater Treatment House, 2x100% Industry Wastewater Lifting Pumps, 2x100% Sanitary Sewage Lifting Pumps, 3x50% Reused Water Pumps, 2x100% Relay Water Pumps ,1x100% Clarifiers, 2x100% Flotation devices, 2x100% Filters, one(1) Coagulant Agent Dosing Equipment, one (1) Coagulant-aids Agent Dosing Equipment, two Emergency Wastewater Pumps, one (1) Sludge Concentrator, one Sludge Dehydrator and so one shall be installed.

Under the Industrial Wastewater Treatment House, some water basin shall be arranged, including Industry Wastewater Regulation Basin, Sanitary Sewage Regulation Basin, CW blowdown Water Regulation Basin, Relay Water Regulation Basin, Reused Water Regulation Basin, Emergency Wastewater Basin, etc.

Process flow diagram of the Industry Wastewater system is as follows:

Industry wastewater discharge point →Industry wastewater drain pipes →Industry wastewater regulation basin →Industry wastewater lifting pumps →clarifier →Flotation devices→ relay water

regulation basin →relay water pump →filters → reused water regulation basin→ reused water lifting pumps→ Cooling tower water basin. Sludge treatment system, such as Sludge Concentrator and Sludge Dehydrator are provided too for this system.

After treatment, the treated oily wastewater will reused as make-up for coal-handling system, bottom ash and fly ash removing system.

1x100% Industry wastewater treatment equipments shall be provided for this project, installed in the Industrial Wastewater Treatment House. Design capacity of the oily wastewater treatment equipments is 1x100m^3/h.

5.10.2 Sanitary Sewage system

This system is designed to collect and treat the sanitary sewage from all the sanitary devices throughout the Power Plant. By the independent sanitary sewage drain pipes the sanitary sewage shall be delivered by gravity to the Sanitary Sewage Regulation Basin which arranged under the Industrial Wastewater Treatment House. By the Sanitary Sewage Lifting Pumps the sanitary sewage shall be delivered to the 1x100% buried-type package Sanitary Sewage Treatment Equipment.

Process flow diagram of the sanitary sewage treatment system is as follows:

Separate sanitary sewage drain point→ sanitary sewage drain pipes→ sanitary sewage regulation basin→ sanitary sewage lifting pumps→ first settling tanks →biochemical treatment equipments →Secondary settling tanks→ filters→ reused in the power plant. Sludge treatment system, such as sludge digestion tank shall be provided too for this system.

After treatment, the treated sanitary sewage will reused as make-up for coal-handling system, bottom ash and fly ash removing system.

Design capacity of the sanitary sewage treatment equipments is 1x5m^3/h.

5.10.3 Coal-polluted Wastewater System

Floor-flushing water discharged from the coal handling system, such as coal convey structure, coal bunker shall be collected and transfer to the Coal-polluted Wastewater Sedimentation Basin which shall be arranged under the Coal- polluted Wastewater Treatment Plant. Rain surface water of the coal stock yard shall be collected and transfer to the Rainstorm Regulating Basin for Coal Stock Yard Area, then by 2x100% Coal Stock Yard Rainstorm Lift Pumps, the surface water shall be transferred to the Coal-polluted Wastewater Sedimentation Basin too. The Rainstorm Regulating Basin for Coal Stock Yard Area will used as Boiler Acid pickling Wastewater Basin too.

After Sedimentation in the Coal-polluted Wastewater Sedimentation Basin, the water shall be lifted to the Package Coal-polluted Wastewater Treatment Equipment to be treated.

Process flow diagram of the Coal-polluted treatment system is as follows:
Floor-flushing water discharged from the coal handling system and rain surface water from the coal stock yard area→ coal-polluted wastewater drain pipes→ coal-polluted wastewater regulation basin→ coal-polluted wastewater lifting pumps→ coal-polluted wastewater treatment equipment→ relay water basin →relay water pumps→ filters→ reused in the power plant.

After treatment, the treated coal-polluted wastewater will reused as make-up for coal-handling system, bottom ash and fly ash removing system.

Design capacity of the coal-polluted wastewater treatment equipments is 1x15m^3/h.

5.11 ELECTRICAL

5.11.1Description of Project

1x330MW generator set shall be installed in the power plant. The generator shall be connected to 132kV switchgear. The generator outlet will set a generator circuit breaker (GCB).

5.11.2 Scope of the Project

The major electrical equipment will include generator, GCB, 132kV switchgear, generator transformer, isolated phase bus, startup/standby transformer, unit auxiliary transformer, non-segregated phase bus, medium voltage switchgear, batteries and battery chargers, UPS, power center, motor control center, cabling, inter-plant communication system, lighting system and miscellaneous equipment and auxiliaries inside the power plant.

The 132kV Switchyard is in the scope of contractor. The work of transmission line is not in the scope of contractor .The interface terminal is at insulator of 132KV outgoing gantry at outgoing side.

5.11.3 Design Criteria

The power supply line and the electrical equipments of water source area are in the scope of contractor.

Electrical design will comply with Chinese design standards of power plant. Electrical equipments will comply with Chinese standards (GB).

5.11.4 Electrical System

1) Generators

The rated capacity of generator shall be matched with turbine's rated output; the maximum continuous rating of generator shall be coordinated with TMCR.

The main parameters of generator table:

description	general plan
Rated capacity	330MW
TMCR condition (the maximum continuous rating of generator)	330MW
Cool style	water-hydrogen-hydrogen
Rated frequency	50Hz
Rated voltage	20kV
Speed	3000r/m
Power factor	0.85 lagging
Sub-transient reactance:	17.4 %
Phase	3
Number of poles	2
Excitation system	static excitation system (within power system stabilizer)

2) Generator Step-up Transformer

The generator step-up transformer shall be outdoor, oil immersed, three-phase, double-winding, off-load tap changer type, with capacity matched with the rated output of the generator in case of the associated unit transformer out of service.

Capacity	400MVA
Rated voltage ratio at on load	138±2x2.5%/ 20kV
Frequency	50Hz
Impedance voltage	14% (assume)
High side neutral grounding	through neutral protection device
Vector group	YN, d11
Tap changer	off-load
Cooling	ODAF/ONAF/ONAN

3) Unit Auxiliary Transformer

The unit auxiliary transformer shall be of the outdoor, three-phase, on-load tap changer type, Consider the grid voltage variation shall be in the range of +10% and –10%, the on load tap changer is selected as ±8x1.25%. The rated capacity of unit transformer shall be 40/28-28MVA.

Capacity	40/28-28MVA
Rated voltage ratio at on load	20±8×1.25%/6.3-6.3kV
Frequency	50Hz
Impedance voltage	19%
Low side neutral grounding	Resistance grounding
Vector group	D, yn1- yn1
Tap changer	On-load
Cooling	ONAF/ONAN

4) Start-up/stand-by Transformer

The start-up/stand-by transformer shall be of the outdoor, three-phase, on-load tap changer type, with capacity same as unit auxiliary power transformer. Consider the grid voltage variation shall be in the range of +10% and –10%, the on load tap changer is selected as ±8x1.25%. The rated capacity of startup/standby transformer shall be 40/28-28MVA

Capacity	40/28-28MVA
Rated voltage ratio at on load	138±8x1.25%/6.3-6.3kV
Frequency	50Hz
Impedance voltage	19%
HV side neutral grounding	through neutral protection device
Low side neutral grounding	Resistance grounding
Vector group	Yn, y0- y0+d
Tap changer	on-load
Cooling	ONAF/ONAN

5) The connection of BTG sets

The generator shall be connected to the generator step-up transformer through insulated phase bursar (IPB).

The high voltage side of unit auxiliary transformer shall be connected to the IPB between the low voltage sides of generator step-up transformer.

For the connections from the HV side of generator step-up transformer to the 132kV switchyard, the steel-cored aluminum strand wire shall be adopted.

6) 132KV System

The 132kV switchyard shall be outdoor, double bus bar wiring type. This switchyard will contain one generator transformer income feeder, one startup/standby transformer feeder, five transmit line feeders,

one bus circuit breaker feeder, and one PT feeder. Five transmit lines will connect to local power grid, system access points should be further considered.

7) Auxiliary Electrical System

The medium voltage switchgears feed motors rated greater than 200kW and low voltage aux transformers.

The low voltage PC switchgears feed motors rated approximately 75kW ~ 200kW and supply MCC power source.

The low voltage MCC switchgears feed motors less than 75kW and other loads.

The medium voltage auxiliary system is 6kV. One unit auxiliary transformer shall be branched off from isolated phase bus duct between generator and generator step-up transformer. The start-up/stand-by transformer will offer start-up and stand-by power supply for unit.

There shall be two 6kV buses which shall be fed by the unit auxiliary transformer via non-segregated phase bus duct. Meanwhile, for this two generating unit, the standby power supply shall be from the start-up/stand-by transformer via non-segregated phase bus duct.

380/220V distribution system will consist of Power Center (PC) and Motor Control Center (MCC).

The low voltage auxiliary electric system will supply power to 380/220V loads through indoor dry-type plant service transformers connected to 6kV medium voltage system. LV service transformers shall be located in the center of loads, and they are always set in couples (double-ended secondary unit substations. These have 2 transformers, 2 buses and a bus tie). PC switchgears will power the loads above 75kW and shall be the power supply of MCC. MCC buses shall be arranged near the site for the loads less than 75kW.

8) Selection of Auxiliary Power equipment

The 6kV switchgear shall be indoor self-standing, metal-clad and draw-out type with lockable doors. The IP classification shall be maintained when the circuit is in the normal, isolated or grounded positions. It is arc flash resistant switchgear.

The switchgear shall be vacuum circuit breakers. Short circuit level shall be 50kA or 40kA. 6kV vacuum circuit breaker and F - C loop shall be used in MV switchgear, capacity of less than or equal to 1000 kW electric motor adopts vacuum contactor (F - C). Low voltage auxiliary transformers shall be of dry type with rated voltage of 6±2×2.5%kV/0.4kV. The connection symbol shall be D,yn11.

The switchgear shall be of indoor, drip-proof, self-standing and draw-out type with lockable

compartments. Short circuit level is 50kA or 40kA. If the 380V switchgear is used in coal system or other heavy dust areas, IP54 classification shall be used unless the switchgear is place in separate enclosed room. IP classification shall be maintained when the circuit is isolated. It is arc flash resistant switchgear.

5.11.5 Layout of Main Electrical Equipments

The generator step-up transformer, start-up/stand-by transformer and the unit auxiliary transformer shall be arranged adjacent the column A beyond the main building. The high voltage side of generator step-up transformer and start-up/stand-by transformer shall be connected to 132kV switchgear through the steel-cored aluminum strand wire. The high voltage side of unit auxiliary transformer shall be connected to the low voltage side of generator transformer by isolated phase bus duct.

The 6kV medium voltage switchgears shall be located in the turbine bay and connected to the unit auxiliary power transformer and start-up/stand-by transformer with non-segregated phase bus duct.

In the main building area, 380V LV voltage switchgears shall be arranged in the centre control building beside boiler and 380V MCC shall be arranged near the center of the electrical loads.

Other auxiliary switchgears for loads in workshops shall be located near the loads.

5.11.6 DC System

The DC system includes 220V system. The DC system will contain two set batteries and two set of charger.

For the main building: the 220V DC system will supply the motors and emergency lighting load, control, protection and measuring load. The 220V DC system will contain two set batteries and two set of charger.

For the switchyard control house: the 220V DC system will supply control, protection and measuring load. The 220V DC system will contain two set batteries and three set of charger.

The charger shall be modified type. The batteries shall be float charging normally. The batteries shall be selected lead-acid maintenance free batteries.

DC Batteries will be sized to meet the load duty cycle requirement as below:

- Momentary loads for 1 minute (closing / tripping of breakers, starting of emergency loads etc.).
- Emergency loads for 1 hour. (Emergency DC drives, emergency lighting, etc.)
- Continuous loads for 1 hour. (Control, aux relays, etc)

5.11.7 UPS System and emergency power system

For the center control room, UPS shall be designed for important load, such as I&C, etc. The UPS system shall be located in the centre control building and switchyard control room. UPS load duty cycle is 1 hour.

One 650kW emergency diesel generator sets shall be provided to maintain essential power supplies for the unit in the event of loss of normal power supplies. The diesel generator set shall be rated to supply essential auxiliary plant, battery chargers, emergency lighting, and minimal operational lighting on a continuous basis until normal supplies are resumed.

The diesel generator shall start-up automatically upon loss AC normal power supplies. It will also be capable of being started, synchronized, loaded up to full rated load, de-loaded and de-synchronized manually locally and from the control room. All necessary instrumentation and electrical protection facilities shall be provided.

5.11.8 Unit Equipment Control and Instrumentation

Electrical system of the auxiliary, G-T equipment shall be controlled and monitored by DCS, and the important signals include G-T equipment, all 6kV and generator step-up transformer 132kV side circuit breaker shall be sent to the DCS.

A network control system (SCADA) shall be provided for implementing monitoring for 132kV switchyard but cannot control electrical equipment for turbine generator unit and electrical auxiliaries system, only can get necessary important information via communication data connection.

There shall be an automatic synchronizer system (ASS) used for the Generator and Transformer.

The ASS will provide auto synchronizing at the G-T H.V side 132kV circuit breaker.

There shall be reserve automatic fast transfer devices for the reserve power put-in. it is including closed transition transfer through synchronism check relay with both buses energized and fast transfer to a bus. All the automatic devices are based on the microprocessor.

5.11.9 Protection System

For this project, the microprocessor-based combination type protection devices for 132kV and 6kV power systems shall be adopted.

For G-T protection, 132kV switchyard protection shall be redundant, the mechanical signal such as gas release will have not redundant requirement.

5.11.10 Inner Communication System

There is one (1) set of paging system for plant intercommunication.

There is one (1) set of telephone system with Private Automatic Branch Exchange (PABX) for plant telecommunication.

There is one (1) set of GPS system for plant.

5.11.11 Cable and Cable Tray

Cables in turbine house will use the fire retardant cable.

Cross linked polyethylene cables shall be used in H.V. & L.V. power distribution Systems. The power cable shall be copper conductor.

The control cables shall be copper conductors, 0.45/0.75kV voltage grade with circular cable construction.

Cables shall be run in trays, trench and directly buried conduits. Cable tray shall be used for main cable route. Cable tray shall be made of hot dip galvanized steel type. Ladder tray shall be generally used for power and control circuit. Solid tray shall be used for instrumentation cable. When cable trays shall be stacked above each other, they shall be arranged from top to bottom in the following order:

MV power cables

LV power cables

Control cables

Communication and signal cables

5.11.12 Lighting System

The lighting system shall be designed. The lighting system shall be adequate illumination all times for the whole project.

5.11.13 Grounding

We will design and furnish the underground grid and the grounding system.

The materials of grounding shall be steel with galvanized.

5.12 INSTRUMENTATION AND CONTROL

5.12.1 General

The I&C system is designed to ensure safe, reliable, available, economic and simple operation and easy coordination to different operation requirements.

The I&C system is designed to accomplish the operation of boiler, turbine, generator and auxiliaries and BOP system from the operator station in the control room. The instrumentation and controls

normally relieve the operator from continual regulation duties and are backed up by interlocks or safety systems which cause preplanned action to prevent unsafe situation developing.

The I&C system uses state of the art technology and hardware. The equipment is designed to meet the vital need for safeguarding the plant, controlling the required output reliably and enabling the station to operate efficiently.

5.12.2 Design Description

The I&C system consists of microprocessor based distributed monitoring and control system and other associated instruments and devices. The DCS system performs the functions of control, alarm, monitoring, self-diagnosing, maintenance guidance, protection and interlock of units to ensure a safe and economic operation of the unit under various operating conditions. The functions of monitoring, self-diagnosing, alarm, and maintenance guidance are highly centralized which utilize LCD with keyboard. The functions of control, protective interlock etc. is distributed extensively in various microprocessor and programmable controllers.

The DCS system incorporates, whenever feasible, self-diagnostic facilities so that internal faults can be detected within the system itself prior to any resulting disturbance to process, and measures are taken to prevent propagation of the faults. Alarm and printing of the faults are also provided.

The fundamental functions of control, alarm monitoring and protection are functionally and physically segregated to the greatest practicable extent so that failure of a function does not result in the failure of other functions. Under any circumstances, the reliability of protection functions is assured.

Alarm function is provided through LCD of DCS and through conventional annunciator. Only grouped and important alarm signals are sent to conventional annunciators.

The protection and interlock system is designed to meet the following criteria against failures.

- No single fault can cause the complete failure of the control system.
- No single fault can cause the boiler or turbine/generator protection system to operate spuriously or cause the protection system inoperative. To meet the stringent requirements for failure and self-diagnosis of the DCS system, measurement redundancy is provided for all such parameters as drum water level, furnace pressure, condenser vacuum, turbine vibration, etc. which can cause a direct unit trip.
- Redundancy of the control system is provided so that no single fault within the control system can cause the failure of the duty equipment and at the same time cause the stand-by equipment to be unavailable. In case of the in-service equipment failure, the stand-by equipment automatically start-up without any interference to the system.

5.12.3 Level of Automation

The instrumentation and control system is a hierarchical structure, group level control can be carried out from operator station with LCDs in the unit control room, and higher level control can be accomplished by the interface to the automatic load dispatch system. Through operator station the whole unit operating management in the unit control room is performed by one shifted operator assigned for operation of the unit, with two operators as assistants for supplemental work.

LCD and keyboard operation shall be established as the center of control and supervision system. The unit start-up, shutdown, normal operation and handling of abnormal operation conditions can be performed automatically with operator monitoring and a few intervention. The operator can also carry out the above mentioned functions by means of remote manual controls through LCD/keyboard in the unit control room according to the information or the operation guide of the LCD's. The automatic control and remote manual operation are able to change mutually over bumplessly at any time. Few pushbuttons or switches shall be provided to shutdown the unit safely when emergency unit state.

Distributed control system (DCS) is adopted for the boiler, turbine, generator auxiliary system, auxiliary equipment and control system to realize the function of data acquisition system (DAS), close control system (CCS), sequence control system (SCS), burner management system (BMS) and unit interlock and protection. Distributed control system (DCS), turbine digital electro-hydraulic control system (DEH), turbine bypass control system (TBPC), turbine supervisory instrument system (TSI), turbine protective device (ETS), boiler soot blowing control system, conventional annunciator and etc. will form a completely coordinated center of information and control to achieve centralized monitoring and control for unit.

Auxiliary plant DCS will be used to monitor and control auxiliary system, including water intake system, make-up water treatment system, waste water treatment system and coal handing system, ash handling system, fuel oil pump house, HVAC etc. There will be three operator stations, two engineer station and printers will be arranged at central control room for auxiliary plant DCS。

5.12.4 Equipment of I&C System

All I&C equipment furnished is proven quality for the utility industry. Instrument and control equipment for outdoor usage is dust-proof. Those for generator hydrogen cooling system are explosion-proof. The control cable used is flameproof.

5.12.5 CCTV System

One set of CCTV System shall be supplied for monitoring the important places and no-attendant places.

The monitors shall be placed in the CCR.

5.12.6 Fire Detection and Alarm Control System

The automatic fire alarm system will consist of with the main control panel in Central Control Room and local panels. When a fire alarm is detected, audible and visible alarm signals shall be provided in the area and in the local and main control panels simultaneously.

Depending on the fire protection requirements, the intelligent smoke, heat, or optical detectors, etc. shall be selected for the buildings and rooms.

5.13 ARCHITECTURE AND CIVIL ENGINEERING

5.13.1 Architecture Works

5.13.1.1 Scope of Architecture Works

The Power Plant shall be provided with all architectural & finishing works required for the following buildings but not limited to:

- Turbine House
- Deaerator and Mill & Bunker Bay
- Boiler
- ESP electric room & Air Compressor House
- Centre control building
- Crusher House
- Transfer Tower
- Make-up water treatment building
- Circulating water feeding room
- Laboratory building
- Bulldozer shed
- Administrative building
- Canteen & bath room
- Gate house
- Warehouse and workshop

5.13.1.2 Main Plant Building

Turbine House

The Turbine House is an enclosed, weather-tight steel framed structure building, which houses the turbine generator and related equipment. The building consists of an operating floor, mezzanine floors and a ground floor.

All external walls will generally be permanent color coated double profiled steel sheet from 1.2m above ground floor up to roof. Brickwork will generally be provided all-round from ground floor up to 1.2m

height. All internal walls shall be of brickwork.

The roof over Turbine House shall be double profiled steel sheet with insulation.

Centre control building beside the Turbine house. The control room is located on the operating floor. Control room shall be provided with false ceiling, and flooring and skirting details ect.

Deaerator and Mill & Bunker Bay

Deaerator and mill & bunker continuous with the Turbine Building on the boiler side. The deaerator, heaters, major pipe lines and electrical cables, coal pulverisers, coalbunkers, tripper conveyors, feeders, ducts and piping shall be arranged in this bay. The floor shall be done by cast-in-situ RCC slab supported by steel beams and girders.

All roofs of Deaerator and Mill Bunker bay shall be RCC slab with protected water proof membrane and heat-insulation. Ground floor slab will have drainage trenches covered with steel grating.

Windows shall be aluminium alloy glazed using 4 mm thick float glass generally and 6 mm thick wired glass shall be used for switchgear room and other room with requirement. All the doors on external walls shall be of double plate flush steel doors. For equipment entry into the service bay specially designed steel sliding / cum folding /rolling shutters shall be provided with appropriate operating mechanism and solid wood door shall be used for office area. All the type of window and door shall be approved by owner in appropriate design stage.

Stairs and platforms shall be provided, as required, for maximum utility and safety. Stairs will have to be provided as per Chinese regulations and any other statutory requirements.

5.13.1.3 Main Finishing Materials of Main Plant Building

Turbine House

ITEM			REMARKS
MAIN FINISHING MATERIALS	STORIES OF BUILDING		3
	GROUND	±0.00m	50mm thickness wearable concrete floor
	FLOOR	Mezzanine	50mm thickness wearable concrete floor
		operation	600x600x6 non-skid fully vitrified tiles
	ROOF INSULATION & WATER PROOF		Double profiled steel sheet with insulation
	DOOR		Hollow steel flush door/ Electric rolling door / fire door
	WINDOWS		aluminum alloy window
	CEILING		emulsion paint
	INNER WALL FACE		emulsion paint
	OUTER WALL FACE		acrylic emulsion paint

Deaerator and Mill & Bunker Bay

ITEM			REMARKS
MAIN FINISHING MATERIALS	STORIES OF BUILDING		6
	GROUND	±0.00m	50mm thickness wearable concrete floor 400x400x10 non-skid fully vitrified tiles(office , toilet) 20mm thickness acid & alkali resistant tile(chemical handling area)
	FLOOR	Mezzanine & operation	50mm thickness wearable concrete floor (cable mezzanine) Ceramic tile (control room, staircase, switchgear room, MCC room, conference room) 20mm thickness acid & alkali resistant tile (like battery room ,UPS room)
	ROOF INSULATION & WATER PROOF		RCC slab with protected water proof membrane and heat-insulation
	DOOR		Hollow steel flush doors, fire resistant doors, wooden flush doors, ect.
	WINDOWS		aluminium alloy window
	CEILING		Aluminum suspended false ceiling for control room ,office area /emulsion paint for other area
	INNER WALL FACE		emulsion paint
	OUTER WALL FACE		acrylic emulsion paint

5.13.2 Civil Structure Part

5.13.2.1 The structure style of the main power house

The main power house shall be of steel structure. The main materials of beams, columns and bracings shall be Hot-rolled shape steel or H-shaped welded steel. The structure system, hinged connection and vertical bracing shall be used for beams and columns in longitudinal direction, while rigid connection and part bracing for beams and columns in transversal direction. The columns shall be pin or rigid at the foundations.

The roof supporting of the turbine house shall be welding H-type plate-girder or steel roof truss with purlins. Purlin and self-insulated waterproof deck steel sheet shall be used for the roof of the turbine house. The crane girders in the turbine house shall be steel girders. Steel coal bunker shall be used with stainless steel liner.

The roof of coal bunker bay and floor slabs of each floor shall be combined structure (with studs) of steel beams and deck-formed reinforcement concrete slabs.

Steel concentrically braced frame or moment frame structure system shall be used for beams and columns of the mezzaline and operating floor of turbine house. The columns shall be pine or rigid at the foundations, and floors shall be combined structure (with studs) of steel beams and deck-formed reinforcement concrete slabs.

The turbine-generator pedestal shall be of cast-in-place R.C. frame structure. The structure shall be arranged independently, and isolated from the surrounding structures. The soleplate for the pedestal of turbine generator shall be raft foundation.

The elevator for boiler shall be of steel structure, and connected with steel platform of boiler by steel beam and support. The machine room of the elevator shall be enclosure of the composite corrugated steel sheets and monolayer corrugated steel sheets under machine room.

The boilers shall be of island-type steel structure system and arranged independently with main power house. Boiler steel shall be designed and supplied by the manufacturer.

The central control building shall be of steel structure, and floors shall be combined structure (with studs) of steel beams and deck-formed reinforcement concrete slabs.

5.13.2.2 Chimney

Height of The chimney is 200m. It is R.C chimney with single steel inner flues. The shell of chimney shall be reinforced concrete structure. Titanium- steel clad plate steel shall be used for chimney inner tube for acid-resisting.

5.13.2.3 Other Auxiliary Buildings and Structures

Concrete frame structures shall be used for crusher house and transferring towers of coal handling system building, and steel truss and steel column used for the design of coal-handling conveyor without enclosure structure. The floor shall be of steel grating.

Other auxiliary building or structures shall be concrete structure or steel structure, which may be determined according to the style and layout of architecture and mechanical.

5.13.2.4 Soil and Foundation

At present, there is no information about the seismic. According to the seismic zoning map, it is presumed, the seismic acceleration is 0.1g, the seismic precautionary intensity is 7 degree as per Chinese code for seismic design of buildings (GB50011).

Because there is no information about the soil situation, the type of the foundation of buildings cannot be confirmed now. So, at this stage, it is presumed, the bored pile foundation shall be used for main

power building zone, boiler zone and chimney, the pile with the dia. 800, and the length 35m. The spread or strip foundation shall be used for other buildings and structures.

5.13.2.5 Structural Design Specifications

Design of all structures in this project shall be in accordance with Chinese codes and standards.

Structures shall be designed to withstand all applied dead, live, wind, equipment, crane, seismic, thermal and construction loads.

Deformations and settlement shall be taken into account. They shall be controlled within allowable limit in Chinese codes.

The quality of all material will conform to the latest national related standards of the People's Republic of China. High strength bolts shall be Chinese Class 10.9S friction-type connection. Steel material shall be Chinese Q345 or Q235. Reinforcement steel would be Chinese HPB300 and HRB400, Concrete shall be conformed to Chinese relative codes and standards.

5.13.2.6 Design Software

All the steel frames shall be analyzed in three-dimensional method as the Chinese of codes and standards using the Software STAADPRO provided by Bentley. All the frame of RC and foundation shall be analyzed in two or three-dimensional method using PKPM, which is excellent software of CHINA ACADEMY OF BUILDING RESERCH.

5.13.3 Hydraulic Structure

5.13.3.1 The structure style of hydraulic Structures

The substructure of pump type house shall be of reinforced concrete box structure underground. The superstructure of the pump type house shall be of reinforced concrete frame structure without wall cladding. The roof shall be of reinforced concrete roof covering waterproof layer.

The substructure of treatment station shall be of reinforced concrete box structure underground. The superstructure of the treatment station shall be of reinforced concrete column-steel truss bent frame structure without cladding. The roof shall be reinforced concrete slab decking on zinc-galvanized sheet.

One natural draft cooling water towers shall be provided for this project. The shell shall be supported on reinforced concrete ring foundation through diagonal columns.

The cold water basin of the tower shall be of reinforced concrete structure.

The house without substructure underground shall be of reinforced concrete frame structure without

cladding. The roof shall be of reinforced concrete roof covering waterproof layer. The foundation of the house shall be of reinforced concrete spread foundation.

The reservoirs shall be of reinforced concrete structure. The design will follow China national typical drawing.

For small structures like ducts, wells and pits, reinforced concrete or concrete structural shall be used.

5.13.3.2 The way of water intake

According to local site conditions, it is proposed to adopt well pump house for this project. The number and location of well pump house to-be-determined.

5.13.3.3 Feature and Base Treatment of Hydraulic Structures

Most of the hydraulic structures are of underground structures, which have deep box foundation. Generally, natural soil base may be satisfied. However, if the soil needs to be improved as per soil investigation report, the ground soil of the structures shall be treated by using piles or compacted gravel bedding as per codes.In this design stage, natural foundation is temporarily considered for deepbox foundation, piles foundation is temporarily considered for shallow foundation and important buildings. The surface of concrete contact with soil shall be painting epoxy asphalt.

The scheme of ground treatment shall be confirm in the next stage, according to the detail geotechnical investigation report.

5.14 Heating Ventilation and Air Conditioning system

5.14.1 Design Conditions

Design outside conditions for Ventilation and Air Conditioning:

Summer dry bulb temperature: 43.2 ℃

Wet bulb temperature: 23.2℃

Design outside conditions for Heating:

Winter dry bulb temperature: 3.9 ℃

Note: The above data refer to LAHORE AIRPORT, Pakistan of in 2009 ASHRAE Handbook-Fundamentals (SI).

Indoor design conditions and system types:

Building name or Room	System Type	Indoor design condition in summer		Indoor design condition in winter	
		^{0}C(DB)	%(RH)	^{0}C(DB)	%(RH)
Central control room	AC	26	50	20	50
Electronic equipment room	AC	26±1	50±10	20±1	50±10
Engineers room	AC	27	/	18	/

Building name or Room	System Type	Indoor design condition in summer		Indoor design condition in winter	
		°C(DB)	%(RH)	°C(DB)	%(RH)
Electric lab room	AC	27	/	18	/
Shift in charge/meeting room	AC	27	/	18	/
Steam Turbine Building	V	Design outdoor+6	/	/	/
Battery Room	AC+V	max.30	/	18	/
Switchgear Room (in main power building)	AC+V	35	/	/	
Switchgear Room(in auxiliary plant building)	AC+V	40	/	/	
Chemical water Treatment Room	V	/	/	/	/
Laboratory	AC+V	27	/	18	/
Offices	AC	27	/	18	/
Local control room	AC	27	/	18	/
Firefighting pump Building	V	/		/	/
Ware Building & Maintenance Room	V	/	/	/	/
Toilets	V	/	/	/	/

Note:

V-----Ventilation system

AC-----Air conditioning system

5.14.2 Heating System

According to local weather parameters, the central heating system will not be designed for this project; electric heating or heat pump air conditioner shall be designed for necessary heating areas.

5.14.3 Ventilation System

1) Ventilation system for Turbine Building

Turbine shall be installed indoor. The indoor temperature will not be above design outdoor+6℃. In summer, the cooling ventilation system shall be provided for Turbine Building. A mechanical air supply and mechanical air exhaust system shall be provided for Turbine Building.

In summer, the evaporative cooling units shall be installed outside of turbine building, supply air into the turbine building and the air shall be exhausted to outside by explosion-proof power ventilator mounted on turbine building roof.

Five (5) units Evaporative Cooling type shall be adopted four (4) operations and one (1) standby.

2) Ventilation system of electrical equipment rooms

The indoor air design conditions in summer for PC switchgear room, 400V switch room, 6KV switch room etc in Main Power Building and Center Control Building will keep indoor temperature under 35°C. The auxiliary switchgear room arranged in other buildings, its indoor temperature for summer will not be higher than 35℃. In summer, the cooling ventilation system shall be provided for the above electrical equipment rooms. Evaporative cooling units will be used for air supply, fans will be used for exhaust air in order to maintain indoor temperature of above rooms.

Emergency ventilation system of all switch rooms	12 times/hr air change rate
Ventilation system for the Cable Interlayer	A natural supply / mechanical exhaust ventilation system with 10 times/hr air change rate taken into account
Ventilation system for the Battery Room	A natural supply / mechanical exhaust ventilation system/ Emergency ventilation systems with 6 times/hr air change rate taken into account shall be supplied for the Battery Room. Fan's motor and electric equipment shall be of explosion-proof, and the fan shall be connected directly with its motor.

3) Ventilation system of other room

Ventilation System of Chemical Feeding Room, Chemical Store room	A natural supply/mechanical exhaust ventilation system with 15 times /hr air change rate taken into account
Ventilation System for Sample Hot Room	A natural supply / mechanical exhaust ventilation system with 10 times/hr air change rate taken into account
Ventilation System for Chemical Water Treatment Plant	A natural intake and mechanical exhaust system with 15 times /hr air change rate taken into account shall be provided for chemical water treatment room. Chemical dosing room shall be maintained under negative pressure continuously by mechanical exhaust system, to prevent chemical gas spreading to adjacent areas. A natural intake and mechanical exhaust system shall be provided for each laboratory, to exhaust inside chemical gas.

	In addition, a mechanical exhaust system shall be provided for each ventilation cabinet in laboratory. Anticorrosive measures shall be taken into account for ventilation equipment and accessories. Fan's motor and electric equipment shall be of anticorrosive measures, and the fan shall be connected directly with its motor.
Ventilation System for Diesel Generator Room	A natural supply / mechanical exhaust ventilation system with 15 times/hr air change rate taken into account
Ventilation System for Pump Room	A natural supply / mechanical exhaust ventilation system with 10 times/hr air change rate taken into account
Ventilation System for Toilet	A natural supply / mechanical exhaust ventilation system with 15 times/hr air change rate taken into

Louvers will be used for air intake; fans will be used for exhaust air in order to maintain indoor temperature of above rooms.

4) Rain protection for Ventilation system equipment

Rain protection cowls/hoods shall be designed to roof exhausters/wall exhausters/supply fans for protecting fans from rain. The hoods/cowls shall be provided with bird screen of heavy gauge expanded metal netting.

5.14.4 Air conditioning System

1) Air conditioning System for CCR and EER

a) The requirement of the AC system for CCR and EER

The Centralized Control Room and Electronic Equipment Room are located in the Central control building. According to the system's requirement, the indoor condition shall be as following.

For CCR:

In summer t=25~27℃ Φ=40~65%

In winter t=20~22℃ Φ=30~60%

For EER:

In summer t=26±1℃ Φ=50±10%

In winter t=20±1℃ Φ=50±10%

b) Design scheme of AC system

Air-handling unit in AHU Room and the related air system shall be designed for Central Control Room, Electronic Equipment Rooms and Computer Room.

The AHU rooms shall be design to handle the air, using the chilled water which supplied from the Central Chilled water Plant (with screw water chilling unit), and to supply the handled air to air conditioned rooms.

2x100% air handling units (one working, one stand-by) for Central Control Room and two air handling units (one working, one stand-by) for each Electronic Equipment Room shall be mounted in the AHU room.

The return air, filtered and mixed with outdoor filtered fresh air, shall be handled by the Air -handling unit and then transported to the air conditioned rooms through air duct system.

c) Operation Control

By temperature control component and humidity control component installed on the return air inlet of air conditioner, the controller in the air conditioner will auto-control the cool coil, electrical heating, humidifier of the AC system so as to adjust the indoor condition of AC required rooms such as temperature and humidity.

d) Fire protection and smoke exhaust

The AC system shall be interlocked with the fire alarm system. The air conditioners, fresh air unit and fire dampers installed in the air duct shall be switch/turn off as soon as fire alarm was sending out and confirmed. Then the fire fighting system will operate. After fire ended, the smoke damper shall be opened and the smoke fans shall be switched on to exhaust smoke and when smoke is entirely exhausted, the smoke fans and the smoke dampers shall be turn off. Then the dampers in the supply duct/return air duct shall be opened, the air conditioners, fresh air unit shall be switched on and the AC system shall be in operation again.

2) Air conditioning for switchgear rooms

The indoor air design conditions in summer for PC switchgear room, 400V/230V switch room, 6kV switch room etc in Main Power Building and Center Control Building are to keep indoor temperature under 35°C. The auxiliary switchgear room arranged in other buildings, its indoor temperature for summer will not be higher than 40℃. In summer, the cooling ventilation system shall be provided for the above electrical equipment rooms.

Emergency ventilation systems of 6kV/400V switchgear room shall be supplied with 12 times/hr air change rate taken into account. The cooling ventilation system shall be supplied by air handling unit.

Chilled water of 7-12℃ for air handling unit shall be supplied by the Chiller Plant of Main Control Building.

3) Air conditioning for local control rooms，offices and duty rooms

Air conditioning for local control rooms，offices and duty room in buildings such as Complex Water Pump Station, Fuel Pump Building, Dust Precipitator Control Room, Ash Handling System Building etc, split air conditioners shall be supplied as above areas.

Separate HVAC systems shall be designed for warehouse area, workshop and laboratories.

Fan coil unit system shall be designed and supplied for the rooms inside the Administration Building , Canteen and T Complex Building with design indoor temperature of 26~28℃。Chilled water of 7-12℃ for fan coil unit shall be supplied from The Chiller Plant of Main Control Building.

4) Central Refrigeration Station

Central Refrigerating Station shall be designed. The following equipments shall be installed in Central Refrigerating Station:

3x50% water-cooled screw type water chillers shall be installed in Central Refrigerating Station, 2 of which are in operation, 1 of which is on standby.

3x50% cooling towers shall be installed in roof of Central Refrigerating Station, 2 of which are in operation, 1 of which is on standby.

3x50% chilled water circulating pumps shall be installed in Central Refrigerating Station, 2 of which are in operation, 1 of which is on standby.

3x50% cooling water circulating pumps shall be installed in Central Refrigerating Station, 2 of which are in operation, 1 of which is on standby.

One make-up water tank shall be installed in Central Refrigerating Station.

2x100% make-up chilled water pumps shall be installed in Central Refrigerating Station, one of which is in operation, one of which is on standby.

2 automatic water strainers shall be installed in Central Refrigerating Station, one for chilled water system, another one for cooling water system.

One supply water header shall be installed in Central Refrigerating Station.

One return water header shall be installed in Central Refrigerating Station.

5.14.5 Dust Suppression and Collection System

Comprehensive dust control system shall be designed for the transfer station, crusher station, coal bunker and coal drop point of coal handling system, and for crusher house of limestone handing system, the system is composed of combination of part or all of following 4 parts:

(a) Inertial dust control skirt;

(b) Circulation pipe;

(c) Micro fog dust suppression system;

(d) Dust collector.

1) Dust Collection System for Bunker Bay

This Comprehensive Dust Control System shall be installed to remove coal-dust, potentially explosive gas released from coal stored in bunker. One (1) Pulse jet type bag dust collector shall be installed one (1) coal bunker, and one set of micro fog dust suppression device shall be mounted in Bunker Bay.

The pulse jet bag dust collector and high pressure and micro fog dust suppression device should be interlocked with the plough unloader.

2) Dust Collection System for transfer station

Two (2) pulse jet type bag dust collectors and one set of micro fog dust suppression system shall be mounted in each transfer tower (one (1) for each belt) conveyor, and interlocked with the relative belt.

5.14.6 Chilled Water Pipe-network

The chilled water pipe-network shall be laid in a pipe trench, with no personnel access.

Insulation of chilled water pipe shall be designed using water-proof material. The insulation material is closed cell fiberglass insulation ply. The outside of the insulation shall be wrapped with galvanized steel sheet of thickness to be confirmed in detailed engineering phase.

5.15 FIRE FIGHTING SYSTEM

5.15.1 System description

The system will involve both outdoor and indoor fire fighting system to be installed in all the buildings and equipment in the plant area. Various fire fighting systems, such as water fire-fighting system (fire hydrant system, automatic sprinkler system, water spray system), shall be selected to provide an appropriate fire protection system for different buildings and equipment according to the specific application.

An adequate number of portable and wheeled fire extinguishers such as carbon-dioxide type, foam type, dry chemical type, will also be provided at strategic locations throughout the plant.

5.15.2 Water Fire Fighting System

The water extinguishing system shall be an independent piping network with firewater tanks and fire fighting pumps. 1x100% motor-driven fire-fighting water pump and 1x100% diesel-driven fire-fighting water pump and one set of pressure-stabilizing device (including two jockey pumps and one pressure-stabilizing tank) shall be installed for the water fire fighting system in the fire water pump house.

The fire fighting piping network will form some ring circuits in the plant areas around the power house

and coal stock yard, etc.. Necessary valves shall be installed to divide the network into several independent sub-networks. If any one section is under emergency overhaul or under maintenance, the network will still be able to supply adequate quantity of water for fire extinguishing system

Indoor and outdoor water hydrants shall be strategically installed for the power plant with hoses and nozzles, etc.

The Automatic Sprinkler System is designed for the places where possibly have higher fire hazard, not easy to evacuate, etc. such as Coal Bay, Coal Conveyors and so on. The system is comprised of wet-type alarm valves, nozzles and pipes mainly.
The Water Spray System is designed for the service of machines and equipment cooling in the event of overheating and fire prevention and extinguishing in the protected area, such as the Generator Transformers, etc. This system is comprised of deluge valves, spray nozzles and pipes mainly.

5.15.3 Portable & wheeled fire extinguishers

Fire extinguishers, including portable extinguishers and wheeled extinguishers, such as Dry Chemical Extinguishers, Foam Extinguishers and Carbon dioxide Extinguishers, shall be deployed strategically throughout the power plant.

5.15.4 Fire Alarm and Detection System

The purpose of the fire alarm and detection system will guarantee a reliable and fault-free early warning system in the event of fire, so that orders for extinguishing the fire can be issued from a central point to the permanently installed fire-extinguishing equipment which is automatically activated.
The fire alarm system will provide for early detection of fires by means of automatically tripping ionization indicators or by means of analytical test for the detection of smoke, and particles from a fire in continuously extracted samples of air.
The alarm signal receiving units shall be so designed that by the use of a standardized alarm unit socket, any of the following type of detectors shall be used with equal facility of any of the fire alarm circuits:

- ionization detector for the detection of smoke and burning gases
- flame detector for the detection of flames
- thermo-differential indicator for detecting a rise in maximum temperature thermo-maximum indicator
- smoke detector for the detection of visible smoke formation

5.15.5 Standards and Regulations

The fire fighting system design complies with NFPA, and the fire fighting system Local will confirmed with fire authority's regulations and requirements (Pakistan laws/regulations).

5.16 FGD SYSTEM

Limestone-gypsum wet desulfurization shall be adopted for this project, and desulfurization efficiency shall be not less than 95%.

For the limestone, it is required that the content of CaCO3 is more than 90% and particle size is less than 20mm. The desulfurization byproduct is gypsum, and it is used for building material.etc.

Since the test of limestone is yet to be finished, the following limestone analysis is assumed for the purpose of this feasibility study:

REAGENT PROPERTIES	
Compound	Percentage (%)
CaCO3	≥90
MgCO3	provide after test
SiO2	provide after test
Al2O3	provide after test
Fe2O3	provide after test
K2O	provide after test
Na2O	provide after test
SO3	provide after test
Others	provide after test

Limestone consumption as follows:

name	unit	limestone consumption (1×330MW)	limestone consumption (1×330MW)
		Performance coal	Worst coal
limestone consumption per hour	t/h	13.1	16.5
limestone consumption per day	h/d	314.4	396
limestone consumption per year	$x10^4$t/y	9.8	12.3

- Note: 24 daily usability hours and 7446 (average value in five years. Allowances shall be granted in the PPA for first year after COD and major maintenance year during operation) yearly usability hours for the project. The content CaCO3 assumed is 90%.

Sulfur dioxide absorbing system and flue gas system are unit system, equipped with 1 set FGD for each boiler. Pulping limestone and gypsum dewatering system are set for one unit.

Absorption tower adopts countercurrent spray tower. There is no GGH, and set bypass flue duct, booster fan is set for desulfurization.

Limestone shall be transported into limestone hopper by self-unloading truck, then through limestone hopper, via belt feeder and lifted to limestone store by bucket elevator. The design interface for limestone handling system and desulfurization system shall be the top of limestone hopper. Through limestone mill and add water for pulp. 1 set of utility of limestone slurry preparation system is for 1 set of FGD. 1 limestone particle bunker is set, and the volume of bunker can satisfy limestone consumption of 3 days for worst coal at BMCR condition.

100% gypsum dehydration is considered, and the moisture content of gypsum is less than 10% after dehydration. 1 set of the gypsum dewatering system is common for 1 sets of FGD. 1 sets of vacuum belt hydro-extractor is set, and there are two vacuum belt hydro-extractor. One vacuum belt hydro-extractor (1 operation, 1 standby) can satisfy the amount gypsum for the unit at worst coal 100% BMCR condition. Dehydration gypsum is stored in the gypsum warehouse; the capacity meets the requirement of gypsum in 48 hours for the unit.

Gypsum production for wet desulphurization is as follows:

name	unit	gypsum production (1×330MW)	gypsum production (1×330MW)
		Performance coal	Worst coal
gypsum production per hour	t/h	23.1	29.1
gypsum production per day	t/d	554.4	698.4
gypsum production per year	$x10^4$t/y	17.2	21.7

Noted:

- 24 daily usability hours and 7446 (average value in five years. Allowances shall be granted in the PPA for first year after COD and major maintenance year during operation) yearly usability hours for the project.

The desulfurization system is not set with independent compressed air system. Air compressor stations of the main building will provide compressed air for desulfurization device instruments, pneumatic valve and maintenance. Desulfurization is set with compressed air storage buffer tank.

One (1) accident slurry tank is set, and the capacity of tank can satisfy individual absorption tower emptying when maintenance is required and other slurry emptying, accident slurry return pump is set.

Desulphurization device is arranged behind boiler, with combination of indoor and outdoor arranged. Slurry preparation and gypsum dewatering system, limestone slurry circulating pump, gypsum slurry pump, absorption tower open layout. Oxidation fan is indoor arrangement

6.0 ENVIRONMENTAL PROTECTION

The Project will conform to the environmental protection laws, regulations, and standards of Pakistan and World Bank/IFC standards of environmental protection. The Project will carry out composition and review system for environmental impact assessment (EIA) and execute the *Three Simultaneousness* system, namely, simultaneous design, construction and operation of both pollution prevention facilities and the main plant. Local consultant, Engineering Consultancy Services Punjab (ECSP) Pvt. has been engaged to conduct the EIA study and the draft EIA reports are already available.

6.1 Atmospheric Emission Limit Values

The atmospheric emission limit values are applicable at the BMCR of the plant. The atmospheric emission limit values are listed in Table 6.1-1.

Table 6.1-1 Atmospheric Emission Limit Values

Substance	Unit	Emission Limit Values
SO_2	mg/Nm^3	900-1500
NOx	mg/Nm^3	510
Particulate Matter (PM)	mg/Nm^3	50

Remark: Emission concentration is corrected as 6% O_2 on dry flue gas.

6.2 Effluents Discharge

Various kinds of wastewater from the Project shall be treated. In the meanwhile effluent discharged outside the boundary of the Project will satisfy the requirements of World Bank/IFC standards of environmental protection. The important limits for treated effluent quality are listed in Table 6.2-1.

Table 6.2-1 the important limits for treated effluent quality

Parameter	Unit	Limits
pH	/	6-9
BOD	mg/L	30
COD	mg/L	125
Total Nitrogen	mg/L	10
Total Phosphorus	mg/L	2
Grease and oil	mg/L	10
TSS	mg/L	50
Total residual chlorine	mg/L	0.2

6.3 Noise Levels

The noise emitted from the Project will not exceed the following values:

The noise level of equipment (at 1 m from the equipment): ≤85 dB (A).

The noise level in Control Room: ≤60 dB (A).

Noise impacts for the Project will not exceed the levels presented in the following table, or result in a maximum increase in background levels of 3 dB (A) at the nearest receptor location off-site.

Receptor	Daytime (07:00-22:00)	Nighttime (22:00-07:00)
Residential; institutional; educational	55 dB(A)	45 dB(A)
Industrial; commercial	70 dB(A)	70 dB(A)

6.4 Pollution Mitigation

1) The electrostatic precipitators (ESP) shall be selected to reduce the emission concentration of PM; the collection efficiency of ESP will not be less than 99.93%.

2) The boiler with low NOx technology shall be adopted to restrict the NOx emission level.

3) The Project will install wet flue gas desulphurization (FGD) device to reduce the SO_2, desulphurization efficiency of FGD system will not be less than 95%.

4) The ground-level concentration of SO_2, NO_2 & PM shall be reduced by using the chimney of 200m height.

5) In order to monitor the emission condition of SO_2, NOx, PM, etc., Continuous Emission Monitoring System (CEMS) in the desulfurization island shall be supplied.

6) The Project will install wastewater treatment systems. The wastewater discharged outside the boundary of the Project shall be treated to meet the requirements of Table 6.2-1.

7) The Project will adopt the low noise equipment. Noise control measures such as acoustic insulation, absorption or acoustic enclosures shall be provided if the noise level of equipment exceed the allowable limit.

8) The industrial solid wastes from the Project including fly ash, bottom ash, FGD gypsum, etc. shall be transported to ash yard by trucks.

6.5 Positive and Negative Influences of Social Environment

Like all development activities, the project being a development activity shall be likely to cause some environmental impacts, that shall be consumption of materials and resources, abstraction and consumption of a large volumes of ground water and surface water, the increases in environmental pollutants, such as flue gas emissions, effluents, noise, industrial solid wastes, etc. during both construction stage and operation stage. Because of their very nature, some impacts will abate with completion of the projects construction stage, e.g. construction noise pollution, construction wastewater, debris generation, materials' consumption, etc.

Despite these negative impacts, this project will have many positive impacts, such as availability of new jobs, income prospects for the contractors and suppliers of goods and services, and above all reduction in the existing shortfall of electricity generation in Punjab. The project will contribute about 300MW electricity to the local power grid during operation stage. Although the project shall be likely to cause some negative impacts, the cumulative positive impacts will outweigh theirs potentially negative

impacts. Moreover, many of the negative impacts shall be mitigatable.

The most likely negative impacts during operation stage will relate to large-scale usage of freshwater and coal, lime stone, increase environmental pollutants in the local environment, such as flue gas emissions (containing Particulate matter, SO_2, NOx, and so on) from the boiler, noise from various machines and equipment, fly ash and bottom slag from burning of coal, FGD gypsum from Wet FGD system. Spillages, leaks and accidental releases shall be likely to constitute another stream of the adverse impacts relating to the project's operation.

After adopted pollution mitigation measures as stated in Clause no. 6.4, environmental pollutants from the Project will meet the requirements of the environmental protection laws, regulations, and standards of Pakistan and World Bank/IFC standards of environmental protection.

7.0 The allocation of human resources

The personnel are based on guaranteeing the safety in production, and is based on the necessary link of the production and operation of power generation enterprises.

The human resources is including the person who are for operation of unit, unit repair, fuel system, management personnel, party work personnel, service management personnel, and the machine. However, the person who is for the main equipment repair, fuel procurement and transportation, the locomotive operation, repair, thermal efficiency, metal supervision, repair, service is not included in the range of the standard allocation.

Item	Allocation	Remark
Total	300persons	
1 For operation	255 persons	
1.1 For operation of unit	105 persons	
1.1.1 CCR	55 persons	
1.1.2 ASH handling	11 persons	
1.1.3 Chemical	16 persons	
（1）Operation for chemical part	23 persons	
（2）Laboratory	15 persons	
1.1.4、FGD	8 persons	
1.2 For maintenance of unit	62 persons	
1.2.1 mechanical	20 persons	
1.2.2 electrical	15 persons	
1.2.3C&I	15 persons	
1.3 Fuel system	79 persons	
1.3.1 Operation	44 persons	
1.3.2 maintenance	20 persons	

Item	Allocation	Remark
1.3.3 fuel management	15 persons	
1.4 others	21 persons	
1.4.1 storage	6 persons	
1.4.2 vehical	3 persons	
2 management	36 persons	
3 The party staff	5 persons	
4 Service management personnel	4 persons	

8.0 BUDGETARY ESTIMATE

8.1 Principles and basis for the compilation

The budgetary estimate is based on Budget Compilation and Calculation Regulation in Electric Power Plant Construction Projects (Version 2013) issued by the National Energy Bureau, People's Republic of China. Adjustments have been made to carter for the price differences between domestic projects in China and overseas projects in Pakistan, as well as taking into account the transportation, insurances and financing requirements and financing costs. Further adjustments have also been made based on quotations from potential suppliers and subcontractors and experiences in similar projects.

8.2. General Assumptions

The following has been assumed while calculating the budgetary estimate. Any changes to these assumptions will result in a change to the budgetary estimate.

8.2.1 Scope of the EPC Cost

The EPC cost includes cost of Main Plant Equipment System, Boiler including Auxiliaries, Steam Turbine Generator (STG)&Auxiliaries, Balance of Plant Equipment System, Other Mechanical Equipment System, Electrical Equipment System and Control & Instrument System, Coal Handling Infrastructure, Engineering & Project Management, Erection &Commissioning, site development and civil works, transportation and transmission cost up to the first gantry of 132kV outgoing line within the boundary of the Project.

The EPC cost also includes insurance premiums (other than Sinosure insurance premium) prior to COD, the Emergency & Safety Spare Parts during commissioning, housing colony for employees and training prior to COD.

The EPC cost is based on Chinese standards, with main plant equipment to be sourced from leading Chinese manufacturers.

The Government of Punjab shall be responsible for the financing and construction of the access roads

to the Project which can also be used by the general public.

The Power Purchaser shall be exclusively responsible for the financing, construction, operation and maintenance of the Interconnection and Transmission Facilities from the first gantry of the 132kV outgoing line within the power complex to the grid.

The Main energy meter and electronic recorder for continuous recording of readings will be provided by Power Purchaser at its own cost.

No cost of utilizing NTDC telecommunication media is assumed.

8.2.2 Taxes and Duties

The taxes and duties of this Project is based on the following assumptions,

1) As per regulations of Policy for Power Generation Projects Year 2002, the following incentives have been offered to IPPs,

(a) Customs duty at the rate of 5% on the import of plant and equipment not manufactured locally.

(b) No levy of sales tax on such plant, machinery and equipment.

(c)Exemption from income tax including turnover rate tax and withholding tax on imports.

(d) Non-Muslims and Non-residents shall be exempted from payment of Zakat on dividends paid by the company.

2) Only 7% withholding tax on local services is assumed. No withholding tax on foreign contractors, sub-contractors, supervisory services and technical services provided by foreign (non-residents) entities has been assumed. No other taxes on payments to be made to the local services or foreign contractor or subcontractors are assumed.

3) Only 7.5% withholding tax on dividend payment is assumed.

8.2.3. Currency and Exchange Rate

1) Both Debt and Equity is assumed in US$.

2) The exchange rate is taken as 6.1 Rmb /USD and 97.1 PKR per USD.

8.2.4. Financing Plan and Financing Cost

The project would be financed in a debt to equity ratio of 75:25. CMEC intends to arrange debt financing from Chinese banks in US$ under the coverage of Sinosure insurance. If financing from local banks or other international banks is also required, adjustments shall be made accordingly. Equity would be raised by CMEC either with its own funds or via equity loan.

The repayment period of the loan is 10 years and the debt repayment will commence from the COD.

As banks can not provide firm offer until the PPA/IA is finalized/signed. The interest rate is tentatively taken as LIBOR (six-month) + 4.5%. LIBOR is tentatively taken as 0.45%.

The arrangement fee is tentatively calculated per 2% of the debt as one-time fee and the commitment fee is calculated per 1.5% of the remaining balance of the debt not drawn down as recurring fees.

8.2.5 Hedging Cost

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

8.2.6. Sinosure Insurance

1) No political risk insurance on equity is included in the project cost.

2) Upfront Sinosure insurance premium @7% on the total debt servicing is included in the project cost. Project cost will be adjusted at the time of COD on the basis of actual Sinosure fee.

8.2.7. Interests during Construction (IDC)

IDC has been calculated on the basis of financing from Chinese banks at tentative 6-month LIBOR of 0.45%, spread over LIBOR of 4.5% per annum, and the projected debt drawn down schedule on quarterly basis,

Year	**Debt Drawdown %**
1st year	33.30%
2nd year	33.30%
3rd year	20.00%
4th year	13.40%

8.2.8. Start-up Expenses and Utilities Costs

Start up expenses and utilities costs associated with fuel cost, cost of chemicals and other consumables for testing and start-up together with utilities expenses (i.e., electricity, water) required to back feed the power complex during testing and commissioning prior to COD are assumed and included in the project cost.

8.2.9 Working Capital

1) The principal amount of the working capital has not been included as part of the project cost.

2) Interest on working capital has been included in the project costs, calculated as follows,

A. Inventory will be equivalent to 30 days at 100% plant load.

B. Receivables equivalent to 45 days of fuel charges at 100% plant load.

Interest on Working Capital has been calculated on the basis of quarterly-KIBOR of 11.91% plus 200 basis point, which will be adjusted for variation in quarterly-KIBOR and weighted average cost of coal inventory.

8.2.10. Cost of Security

No cost of security is included either during construction or operation of the project..

8.2.11. Cost of Water Charges

No cost of water charges is included either during construction or operation of the project.

8.2.12. Secondary or Backup Fuel

The plant will not have any secondary or backup fuel. However, heavy furnace oil (HFO) and diesel fuels will be used for start-up purposes.

8.2.13 Base Load

The Project is designed as base load power plant. The calculations of the proposed tariff are also based on base load assumptions. This is also critical to ensure that the plant is able to support its obligations of paying capacity price to the integrated coal mines.

8.2.14. Black Start Facility

Cost of black start facility has not been assumed as part of the Project Costs.

8.3 Initial investment estimation

Following is the estimated capital cost the Project,

Project Cost Heads	**Million US$**
Capital Expenditure	**487.62**
EPC Cost	450.09
Customs Duties (5% of Plant and Equipment)	11.25
Non-EPC Costs	
- Land Acquisition	3.78
- Project Development Cost Prior to Financial Close	6.00
- Sponsor's Costs during Construction	8.00
- Start-up Expenses and Utilities Costs	8.50
Financial Charges	**101.36**
Financing Fees & Charges	18.56
Interest During Construction	44.03
Sinosure	38.77

Total Capital Cost of the Project	588.98

8.4 Economic Evaluation

Due to the peculiarities of this project, CMEC intends to apply for cost-plus tariff to National Electric Power Regulatory Authority (NEPRA), based on the tariff petition regulations.

As integrated coal mines will be developed to supply coal to this Project, coal price mechanism needs to be determined for these dedicated coal mines. CMEC has proposed cost-plus coal pricing mechanism to the Government of Punjab for the captive coal mines. Under the proposed cost-plus pricing mechanism, the Mining Project will also be based on guaranteed IRR and cost pass-through like the current IPP structure for power projects.

Given the considerations of the above, no detailed economic evaluation is conducted at this stage, pending the finalization of tariff determination and coal price mechanism.

Estimated Return on Equity

This Project is indigenous coal based power plant. Two reference Return on Equity values have been determined by NEPRA, i.e., 30.65% per annum (or Equity IRR of 20%) for Thar coal based power plants having construction period of 40 months, and 26.5% per annum (or Equity IRR of 18%) for other local coal based power plants having construction period of 40 months.

To date, there's no reference of local coal based power plants other than the on-going Thar Coal based power projects and the Salt Range coal based power project. Given the significance of this Project and its similarities to Thar Coal based power projects, the Return on Equity for this Project is set at 30.65% per annum (or Equity IRR of 20%), on an unbiased basis.

9.0 CONCLUSION AND SUGGESTION

9.1 CONCLUSION

Based on the Feasibility Study for this Project, following is the summary of general data for this Project.

Land area within enclosure wall of plant site	20hm^2
Land area for unit capacity	0.15m^2/kW
Rent land for the construction	12.00hm^2
Building coefficient	38.5%
Coefficient of utilization	65%
Volume of earthwork for plant site	
Estimated Excavation	80,000m^3
Fill	120,000m^3
Ratio of green space	15%

Annually available usability operation hours	7,446h
Gypsum production for design coal	1.619x105t/a
Water Consumption Rate	0.067m^3/S.GW（Summer）
Total PM emissions (Designed coal)）	300 t/a
Total SO2 emissions (Designed coal)	7,700 t/a
Total nox emissions (Designed coal)	3,600 t/a

9.2 SUGGESTION

9.2.1 More detailed geotechnical and hydro geological Investigations on the site shall be completed as soon as possible.

9.2.2 Approval on Environmental Impact Assessment from local government needs to be obtained as soon as possible.

9.2.3 Transportation conditions are not satisfying at present. Access roads from coal mines to the power plant need to be upgraded by the local government.

9.2.4 New and large coal mines should be exploited to ensure sustainable coal supply.

9.2.5 As the contents of ash and sulphur of coal are extraordinarily high, which will cause adverse impact on the boiler and flue auxiliary system, it is suggested that coal pre-treatment system should be built to reduce contents of ash and sulphur in the raw coal to meet the requirements of the power plant.

9.2.6 Sovereign guarantee for the captive coal mines shall be obtained from the Government of Pakistan to facilitate financing from lenders.