



The Registrar
National Electric Power Regulatory Authority (NEPRA)
NEPRA Office Building
Sector G-5/1,
Attaturk Avenue (East),
Islamabad

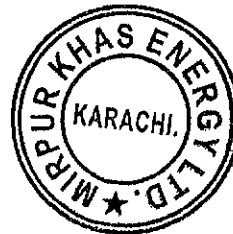
Subject: Application for a Generation License

I, Aslam Faruque, Chief Executive, being the duly authorized representative of **Mirpurkhas Energy Limited** by virtue of Resolution of Board of Directors dated December 16, 2016, hereby apply to the National Electric Power Regulatory Authority for the grant of a Generation License to Mirpurkhas Energy Limited pursuant to Section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

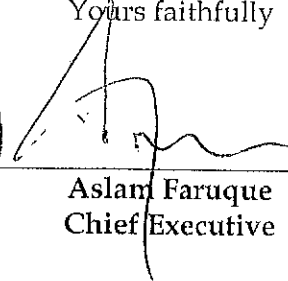
I certify that the documents-in-support attached with this application are prepared and submitted in conformity with the provisions of the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, and undertake to abide by the terms and provisions 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 Bank Draft No. 02982508 dated 09-01-17 drawn on Bank Al-Habab, in the sum of PKR. 292,384/- being the non-refundable 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.

Date: 10-01-17



Yours faithfully


Aslam Faruque
Chief Executive

Registered Office / Factory:
Sub Post Office Sugar Mill Jamrao, Umerkot Road, Mirpurkhas, Pakistan.
Head Office: Modern Motros House, Beaumont Road, Karachi-75530, Pakistan
UAN: +92 - 21-111-354-111 Fax: +92 - 21-35688036 Web: www.gfg.com.pk



**EXTRACTS OF THE RESOLUTIONS PASSED
BY THE OF BOARD OF DIRECTORS OF
MIRPURKHAS ENERGY LIMITED
AS ON DECEMBER 16, 2016**


The Board of Directors of **Mirpurkhas Energy Limited** a public company duly formed and registered in the Islamic Republic of Pakistan having incorporation No. 0101020 (the **Company**) and having its registered office at Sub Post Office Sugar Mills Jamrao, Umerkot Road, Mirpurkhas in their meeting held on December 16, 2016, passed the following resolutions:

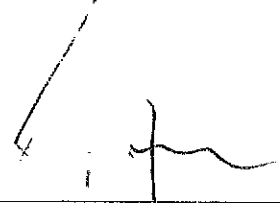
Unanimously Resolved that the Company should approach National Electric Power Regulatory Authority (NEPRA) for Generation License under the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

Further Resolved, that Mr. Aslam Faruque, Chief Executive, Mr. Wasif Khalid Director, Mr. Abid Akber Vazir, Director & Company Secretary and Mr. Naveed Siddique, GM Energy Projects of the Company be and are hereby jointly and singly authorized to do any or all of the following acts, deeds and things, on behalf of the Company, in connection with this application to be filed with NEPRA under the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 and the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999.

- Represent the Company before NEPRA, and in doing so perform all lawful acts, deeds and things, including but not limited to filing, signing, presenting, modifying, amending, withdrawing applications and other documents, responding to any queries and meeting any objections, receiving notices and documents; and
- Do all acts, deeds and things, which are ancillary and incidental to the afore-said purposes.

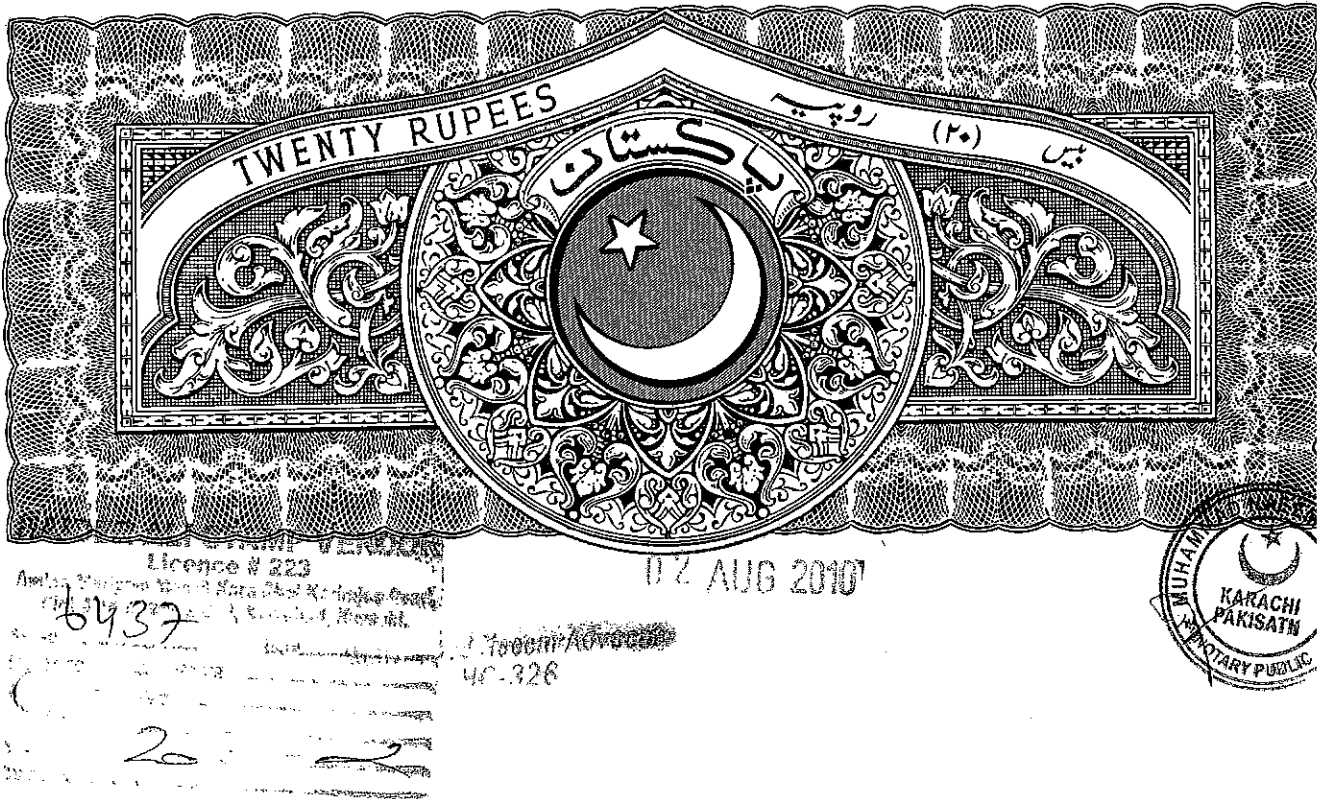
Further Resolved, that extracts of this resolution be provided to the NEPRA with the seal/stamp duly affixed thereon.



Director &
Company Secretary
Abid Akber Vazir

Chief Executive
Aslam Faruque

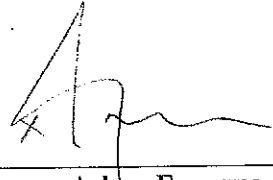
Date: 16-12-2016



AFFIDAVIT

I, **Aslam Faruque** S/o. Zahid Faruque CNIC No. 42301-6351391-7 **Chief Executive**, Mirpurkhas Energy Limited hereby solemnly affirm and declare that the contents of the accompanying 'Application for Generation License' including all supporting documents are true and correct to the best of my knowledge and belief and that nothing has been concealed.

DEPONENT

Signature: 
 Chief Executive: Aslam Faruque
 CNIC: 42301-6351391-7

Verified on _____ that the information stated above is true and correct.

ATTESTED
 Muhammad Naeem (Advocate)
 M.A.L.L.B. HC-326
NOTARY PUBLIC
 PAKISTAN



A022146

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE, KARACHI

CERTIFICATE OF INCORPORATION

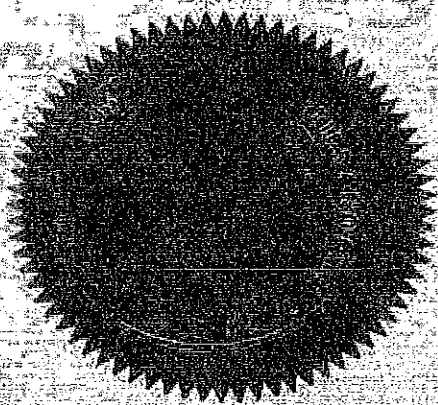
[Under section 32 of the Companies Ordinance, 1984 (XLVII of 1984)]

Corporate Universal Identification No. 0101020

I hereby certify that MIRPURKHAS ENERGY LIMITED is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is limited by shares.

Given under my hand at Karachi this Fourth day of August, Two Thousand and Sixteen.

Incorporation fee Rs. 410,500/- only



(Zia ul Rashid Abbasi)
Joint Registrar of Companies
Karachi



Certified to be True Copy

Joint Registrar of Companies

18/8/16

THE COMPANIES ORDINANCE 1984
(A Company Limited By Shares)

MEMORANDUM OF ASSOCIATION

OF

MIRPURKHAS ENERGY LIMITED

- I.** The name of the Company is "**MIRPURKHAS ENERGY LIMITED.**"
- II.** The Registered office of the Company will be situated in the Province of Sindh.
- III.** The objects for which the Company is established are to undertake any or all of the following business in and outside Pakistan.
 1. To design, develop, build, establish, own, operate, maintain and manage electric power generation plants for the generation of electric power through different methods and to sell, supply and transmit the electric power so generated subject to prior permission from the Authorities, if required.
 2. To generate and produce electric power by conventional and non-conventional methods including but not limited to power generation from bagasse, coal, gas, lignite, oil, biomass, waste, thermal, solar, wind, tidal waves and all other available sources of power generation.
 3. To establish, erect, setup, construct, equip, operate, use, manage, maintain and run electric power generating projects and transmission systems for generating power by using wind, fuel, nuclear, thermal, geothermal power station, solar, hydro, bagasse, coal, steam, and/or any other alternative, renewable energy sources and bio-energy to generate electricity and in this regard establish power grid station, switching, conversion, and transmission facilities, grid stations, cables, overhead lines, sub-stations, switching stations, tunnels, cable bridges, link boxes, heat pumps, plant and equipment, transmission towers, buildings, workshops and other facilities as may from time to time be necessary for the attainment of the objects of the company.
 4. To carry on the business of establishing, operating and managing electric power generating projects and transmission systems for generating and supplying electric power and to manufacture, assemble, acquire and supply all necessary power stations, transmission systems cables, wires, lines, accumulators, lamps and works to generate, accumulate, distribute and supply electricity to customers both public and private, including but not limited to cities, towns, streets, docks, market theaters, buildings, industries, utilities and places both public and private and for any and all other purposes for which energy can be employed.
 5. To generate, produce and sell power to utility companies, power distribution networks and organizations in the power sector, within and outside the country.
 6. To setup, operate and manage one or more power plants in order to generate, sell and supply electricity to industrial and other consumers, through distribution networks established, owned and operated by the Company itself or by any other person, corporate body, autonomous or semiautonomous corporation or authority or local body, and for that purposes to acquire land, whether freehold or leasehold, machinery

and equipment, and construct, install, operate and maintain thereon power houses, civil and mechanical works and structures, turbines, boilers, cooling towers, grid stations, transmission towers, power lines, buildings, workshops and other facilities as may from time to time be necessary for the attainment of the objects of the Company.

7. To enter into any arrangements with the Government of Pakistan or any local or foreign government or with any supreme, national, municipal or local authority, or with any person and at any place where the Company may have interest that may be conducive to the Company's objects, or any of them in any mode and to obtain from such government or authority, or other persons any rights, privileges and concessions which the Company may think desirable to obtain and to carry out, exercise and comply with any such arrangements, rights, privileges and concessions.
8. To apply for, tender, purchase, or otherwise acquire any contracts, sub-contracts, licenses and concessions for or in relation to the objects of the Company herein mentioned or any of them and to undertake, execute, carry out, dispose of or otherwise turn to account the same.
9. To produce, refine, sell, supply, market, distribute, transport and otherwise dispose of crude oil, condensate LPG, NGL and natural gas and refinery gases and by-products pursuant to any of the objects mentioned in this Memorandum for domestic, commercial or industrial uses or for lighting, heating, power generation or any other purposes whatsoever.
10. To undertake business in the fields relating to hydel, thermal, solar and wind power, including any controls, protection, communication and instrumentation systems or other equipment required for power plants, substations, industrial installations, pumping compressor stations and energy conversion system.
11. To offer and to engage in supply, implementation and installation of EHV and HV transmission lines, medium and low voltage overhead and underground distributions network, high voltage underground cables, and low voltage AC and DC installations, rectifier, capacitor installations and consumer services.
12. To act as electrical, mechanical or civil work contractors to local and foreign Governments, agencies, authorities, municipalities, autonomous corporations, private and public companies in the power sector.
13. To purchase and import machinery, parts or equipment and any other related items required in connection with any of the objects of the Company in any manner the Company may think fit.
14. To borrow, procure, raise money in local or any foreign currency from banks, financial institutions, multilaterals, non-banking finance companies, group company(ies) or other persons and to avail finances under any Islamic financing scheme, as may be required by the Company from time to time on terms that the Company may deem appropriate and to provide security in respect of any borrowings or other liabilities or obligations of the Company in such form and such manner as the Company may deem fit, including or hypothecation of its present or future property in full or in part.
15. To raise funds by the issue of shares, stocks, bonds, debentures, Participation Term Certificates, Term Finance Certificates, or any other form of redeemable capital or

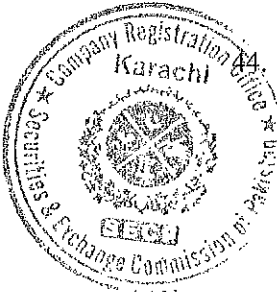
securities charged or based upon the undertaking of the Company, or any part of its property, both present and future or against any other security that the Company may deem fit.

16. To purchase, sell, exchange, improve, mortgage, charge, rent, let or lease, hire, surrender, licence, accept surrender of, and otherwise acquire and/or deal with any freehold, leasehold or other property, chattels and effects, whether real or personal or immovable or movable or any interest therein.
17. To open accounts with any Bank or Banks and to draw, make, accept, endorse, execute, issue, negotiate and discount cheques, promissory notes, bills of exchange, bills of lading, warrants, deposit notes, debentures, letter of credit and other negotiable instruments and securities.
18. To own, establish, run and maintain offices, branches and agencies all over Pakistan or elsewhere for the development of business of the Company and to incorporate and invest in any subsidiaries or other companies.
19. To invest surplus money of the Company in shares, stocks or securities of any company, debentures, debenture stocks or in any investments, short term and long term participation, term finance certificates or any other Government Securities in such manner as may from time to time be decided by the Directors and in accordance with the relevant laws applicable in Pakistan, without indulging into non-banking finance business, banking business or the business of an investment company or any other unlawful business.
20. To guarantee the performance of contracts, agreements, obligations or discharge of any debt of the Company or on behalf of any other company or person subject to the applicable provisions of the Companies Ordinance, 1984 in relation to the payment of any financial facility including but not limited to loans, advances, letters of credit or other obligations through creation of any or all types of mortgages, charges, pledges, hypothecations, on execution of the usual banking documents or instruments or otherwise encumbrance on any or all of the movable and immovable properties of the Company, either present or future or both and issuance of any other securities or sureties by any means in favour of banks, non-banking finance companies (NBFCs) or any financial institutions and to borrow money for the purposes of the Company on such terms and conditions as may be considered proper.
21. To enter into arrangements with the Government or any authority, whether supreme, municipal, local or otherwise, or any corporation, company, or persons that may seem conducive to the Company's objects and to obtain from any such Government, authority, corporation, company or person any charters, contracts, rights, privileges and commission which the Company may think desirable and to undertake any actions required to procure the obtaining of such charter, contracts, rights, privileges, or commission and to carry on exercise and comply with any such charters, contracts, decrees, rights, privileges and concessions.
22. To sell, transfer, mortgage, pledge, exchange or otherwise dispose of the whole or any part of the property or the undertaking of the Company, either together or in portions for such consideration as the Company may think fit and in particular, for shares, debenture-stock or securities of any Company purchasing the same or to any other legal entity or person, by other means, permissible under the law.

23. To carry out joint venture agreements with other companies or countries within the scope of the objects of the Company.
24. To pay all costs, charges and expenses, if any, incidental to the promotion, formation, registration and establishment of the Company.
25. To apply for, buy or otherwise acquire and use any patent design, copyright, licence, concession, convenience, innovation, invention, trademarks, rights, privileges and the like in Pakistan or elsewhere, which may for the time being appear to be useful or valuable for adding to the efficiency or productivity of the Company's business, as permissible under the law.
26. To establish, promote or assist in establishing or promoting and subscribe to or become a member of any other company, association or firm whose objects are similar or in part similar to the objects of this Company or the establishment or promotion of which may be beneficial to the Company, as permissible under the law.
27. To establish and support or aid in the establishment and support of associations, institutions, funds and conveniences calculated to benefit the directors, employees, ex-employees of the Company or any dependent thereof and to grant pensions, gratuities, allowances, relief and payments in any manner calculated to benefit the persons described herein.
28. To apply for and obtain necessary consents, permissions and licences from any Government, state, local and other authorities for enabling the Company to carry on any of its objects into effect as and when required by law.
29. To cause the Company to be registered or recognized in any foreign country and carry on its business activities in any part of the world.
30. To create provident fund, gratuity fund, pension fund, reserve fund, sinking fund, insurance fund, or any other special fund conducive to the interest of the Company.
31. To capitalize such portion of the profits, accumulated profits or reserves of the Company as are not distributed amongst shareholders of the Company in the form of dividend and as the Directors of the Company may think fit, to issue bonus shares as fully paid-up in favour of the shareholders of the Company.
32. To employ personnel or employees or to contract with any third party, as may be required by the Company, for such time and on such terms and conditions as the Company may deem fit, to enable the attainment of any of the objects of the Company.
33. To engage or appoint or obtain services from consultants, advisers, architects, engineers, technicians, advocates, lawyers, solicitors, attorneys, agents, brokers, doctors, professionals/specialists on such terms and conditions as may be deemed suitable.
34. To pay, satisfy, or compromise any claims made against the Company which it may seem expedient to pay, satisfy or compromise, notwithstanding that the same may not be valid in law.

35. To remunerate Directors, officials, servants of the Company or any other person or firm or company rendering services to this Company, out of, or in proportion to the returns or profits of the Company or otherwise as the Company may think proper, either by cash payment and/or by the allotment to him or them shares or securities of the Company credited as paid up in full as may be thought expedient in accordance with the laws to which the Company may be subject.
36. To amalgamate, merge with, absorb, reconstruct, de-merge, acquire or take over any other company or the whole or part of any undertaking having objects altogether or in part similar to those of the Company or carrying on any business capable of being conducted so as directly or indirectly to benefit this Company, whether by sale or purchase of the assets, property or undertaking, or divestiture of the whole or part of the undertaking of the Company or by partnership or any arrangement in the nature of partnership or in any other manner or to enter into and carry into effect any arrangement, or for sharing of profits, with any partnership undertaking or person carrying on business within the objects of this Company.
37. To join or become members of any association company or society formed or to be formed for the protection or advancement of the interests of the Company or its employees or otherwise engaged in any trade or business and to promote subscribe to or subsidise any association, company or society.
38. To make a donation of any belongings of the Company of whatsoever kind or where so ever situated to any person, persons, corporation or corporations to achieve the objects of the Company but so that no gift involving reduction of capital shall be made except with the sanction (if any) for the time being required by law.
39. To carry on any other business which may seem to the Company capable of being conveniently carried on in connection with any of the above or hereinafter mentioned business or calculated directly or indirectly to enhance the value or render profitable any of the Company's properties and rights except banking, finance, investment or any other unlawful business.
40. To do and perform all other acts and things as are incidental or conducive to the attainment of the objects of the Company.
41. To insure the Company against the risk or peril of loss, damage, destructions, demolition or diminution and generally take measures for the safe custody, defence and protection of the Company's interests, assets, moveable and immovable properties, records, documents, belongings and man power and take out any insurance policies or enter into any contracts of insurance, guarantee or indemnify for attaining the aforesaid objectives. Without limiting the generality of the foregoing to take out marine, hull, fire, motor and miscellaneous accident, personal accident, fidelity guarantee, group insurance, explosion, third party claims, loss of profit, machinery breakdown, business interruption, workmen's compensation and all other insurances as may be considered necessary.
42. To adopt such means (both in and outside Pakistan) of promotion, marketing and making known and advertising the products and services of the Company as may seem expedient subject to the laws to which the Company may be subject.

43. It is, hereby, undertaken that the Company shall not engage in banking business or Forex, illegal brokerage, or any business of investment company or non-banking finance, company or insurance or leasing or business of managing agency or in any unlawful business and that nothing contained in the object clauses shall be so construed to entitle it to engage in such business directly or indirectly and the Company shall not launch multi-level marketing (MLM) Pyramid and Ponzi schemes.

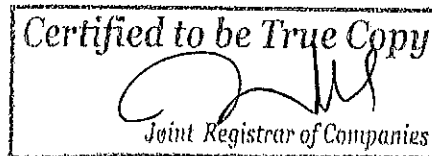


44. It is undertaken that the Company shall not advertise or distribute/circulate any pamphlet, other means of promotion or negotiation, offer for sale or take advance money for further sale of plots, houses, flats, etc., to the general public or individual unless such plots, houses or flats etc., have been acquired and are developed by the Company and shall not indulge in any sort of housing finance company business as mentioned in the Non-Banking Finance Companies (Establishment and Regulation) Rules, 2003.

45. Notwithstanding anything stated in any objects clause, the Company shall obtain such other approvals or licenses from the competent authorities, as may be required under any applicable law for the time being in force, to undertake a particular business.

IV. The liability of the members is limited.

V. The Authorized Share Capital of the Company is Rs. 100,000,000/-, (Rupees One Hundred Million Only) divided into 10,000,000 (Ten Million) shares of Rs.10/- (Rupees Ten), each, comprising of such classes and kinds as may be permissible under the Companies Ordinance, 1984 or any other statutory enactment or modification thereof or instrument as may for the time being be applicable to the Company.



22/11/16

We, the several persons whose names and addresses are hereunder subscribed, are desirous of being formed into a Company, in pursuance of this **Memorandum of Association**, and we respectively agree to take the number of shares in the capital of the Company set opposite our respective names:

Name and surname with father's/husband's name (present & former name) in full and block letter	Nationality with any former nationality	Occupation	Residential address in full	Number of shares taken by each subscriber	Signature
Mirpurkhas Sugar Mills Ltd. CUNL 0001893 Holding Company (through Abid Akber Vazir)	Pakistani	Business	2 nd Floor, Modern Motors House, Beaumont Road, Karachi	94 (ninety-four)	
Mr. Aslam Faruque S/o. (Late) Zahid Faruque CNIC # 42301-6351391-7	Pakistani	Business	141, Street 6, Off: Khyab-e- Bukhari, Ph- VI, D.H.A, Karachi.	01 (One)	
Mr. Shehryar Faruque S/o. (Late) Mahmood Faruque CNIC # 42301-9099307-3	Pakistani	Business	13-A/II, 2nd Sunset Street, D.H.A, Karachi.	01 (One)	
Mr. Tariq Faruque S/o. (Late) Iqbal Faruque CNIC # 42301-1565001-1	Pakistani	Business	13-A/I, 2nd Sunset Street, D.H.A, Karachi.	01 (One)	
Mr. Abid Akber Vazir S/o. Akbar D. Vazir CNIC # 42301-3233346-1	Pakistani	Business	121/I, 6th Street, Khayab-e- Rahat, Ph-VI, D.H.A, Karachi.	01 (One)	
Mr. Yasir Masood S/o. Masood Ahmed CNIC # 42301-6096167-7	Pakistani	Business	88/I, Street 25, Khayab -e- Saher, Ph- VI, D.H.A, Karachi	01 (One)	
Mr. Wasif Khalid S/o. Khalid Wahab CNIC # 42101-1893587-9	Pakistani	Business	D-30, Block "N" North Nazimabad, Karachi.	01 (One)	
				100 (Hundred)	

Dated this 18th day of July 2016

WITNESS TO ABOVE SIGNATURES:

Full Name: NIFT Pvt. Ltd. Signature: _____
Full Address: 5th Floor, AWT Plaza, I.I. Chundrigar Road, Karachi, 74200

**THE COMPANIES ORDINANCE, 1984
(COMPANY LIMITED BY SHARES)**

ARTICLES OF ASSOCIATION

OF

MIRPURKHAS ENERGY LIMITED

PRELIMINARY

1. The regulations contained in Table 'A' in the First Schedule to the Companies Ordinance, 1984 shall not apply to the Company except in so far as the same are reproduced, contained or deemed to be contained in or expressly made applicable by these Articles or the Ordinance.

**Table 'A' not
to apply**

2. The marginal notes hereto shall not effect the construction hereof in these Presents, unless there be something in the subject or context inconsistent therewith, the following terms shall have the meanings assigned to them hereunder.

Interpretation

"Articles" means these Articles of Association as originally framed or as from time to time altered by Special Resolution.

'The Articles'

"Board" means the Board of Directors of the Company for the time being.

'The Board'

"Company" means **MIRPURKHAS ENERGY LIMITED**.

**'The Company'
or 'this Company'**

"Chief Executive" means the Managing Director of the Company, by whatever name called appointed pursuant to the Ordinance.

**'The Chief
Executive'**

"Chairman" means the Chairman of the Board of the Company, appointed from time to time pursuant to these Articles.

'The Chairman'

"Directors" mean the Directors for the time being of the Company including alternate Directors for the time being of the Company.

'The Directors'

"Dividend" includes bonus.

'Dividend'

"Financial Statements" means a balance sheet, profit and loss account, cash flow statement, statement showing changes in equity, accounting policies and explanatory notes."

'Financial Statements'

"In writing" and **"Written"** includes printing, litho-graphy, typewriting and other modes of representing or reproducing words in a visible form.

'In writing' and 'written'

"Member" means a member of the Company, as defined in Section 2(1)(21) of the Ordinance.

'Member'

"Month" means calendar month.

'Month'

"Ordinance" means the Companies Ordinance, 1984 or any statutory modification or re-enactment thereof for the time being in force.

'The Ordinance'

"Office" means the Registered Office for the time being of the Company.

'The Office'

"Proxy" includes an attorney duly constituted under a power of attorney.

'Proxy'

"Person" includes the Government of Pakistan, the Government of the Provinces, Corporations, Associations, Bodies Corporate as well as individuals.

'Person'

"Registrar" means a Registrar, an Additional Registrar, a Joint Registrar, a deputy Registrar or an Assistant Registrar of Companies.

'The Registrar'

"Register" means the Register of Members to be kept pursuant to Section 147 of the Ordinance.

'The Register'

"Redeemable Capital" means the Redeemable Capital, as defined in Section 2(1)(30A) of the Ordinance.

'The Redeemable Capital'

"Special Resolution" has the same meaning as is assigned thereto by Section 2(1)(36) of the Ordinance.

'Special Resolution'

"Secretary" means the Secretary for the time being of the Company.

'The Secretary'

"Seal" means the Common Seal of the Company.

'Seal'

Words importing the singular number shall include the plural number and vice versa.

'Singular' and 'plural number'

Words importing the masculine gender shall include the feminine gender.

'Gender'

Unless the context otherwise requires or otherwise defined herein, words or expressions contained in these Articles shall bear the same meaning as in the Ordinance.

BUSINESS

3. The Company shall not commence or exercise borrowing powers until a certificate of commencement of business has been obtained as required by the Ordinance.

Business

CAPITAL

4. The authorized capital of the Company is **Rs. 100,000,000/-**, (**Rupees One Hundred Million Only**) divided into **10,000,000 (Ten Million)** shares of **Rs.10/- (Rupees Ten)** each. "**minimum subscription**" within the meaning of the Ordinance, shall be **Rs. 100,000**.

Authorized Capital

5. The Directors may, with the sanction of the Company in general meeting, increase the authorized share capital by such sum as the resolution may prescribe, subject nevertheless to the provisions of the Ordinance. Variations, including abrogation, revocation or enhancement in the rights of holders of shares of any class shall be effected only in accordance with the provisions of the Ordinance.

Alteration of Authorized Capital

6. The Directors shall, as regards any allotment of shares, duly comply with the applicable provisions of the Companies Ordinance.

Return as to allotments

7. The new shares consistent with the provisions of the Ordinance shall be issued upon such terms and conditions and with such rights and privileges annexed thereto, as the resolution passed in a general meeting creating the same shall direct and if no direction be given, as the Directors shall determine.

How far new shares to rank with shares of original capital

8. The Company may increase the capital of the Company by the issue of further shares and may decide to whom such shares shall be offered and in absence of such determination, the shares shall be under the control of the Directors who may allot or otherwise dispose off the same to such persons, on such terms and conditions and at such times, as the Directors, subject to the provisions of the Ordinance, may deem fit and subject to Section 73(1)(b) of the Ordinance to give to any person for such consideration as the Board deems fit, in payment or part payment for any property sold

Further issue of Capital

or transferred, goods or machinery supplied or for services rendered to the Company in or about the formation or promotion of the Company or the conduct of its business or in satisfaction of any outstanding debt or obligation of the Company, and with power to issue shares either at par or at premium and, subject to the provisions of the Ordinance, at a discount, provided always that upon the issue of further shares, the Directors shall, offer such shares to the members in proportion to the existing shares held by each member and such offer shall be made by notice specifying the number of shares to which a member is entitled and limiting a time within which the offer if not accepted will be deemed to be declined and after the expiration of such time or on receipt of information from the member to whom such notice is given that he declines to accept the same, the directors may dispose off such shares as provided in the Ordinance. The new shares shall be subject to the same provisions with reference to transfer, transmission and otherwise as the shares in the original share capital.

9. A resolution by which any share is sub-divided or consolidated may, subject to the Ordinance, determine that as between holders of shares resulting from sub-division or consolidation, rights of profits, votes and other benefit attaching to them will be proportionate to their paid up value and where shares issued are sub-divided or consolidated, shares of the same class as those previously issued, and the rights attaching to them, subject as aforesaid, shall be the same as those attaching to the shares previously held.
10. The Company may, by Special Resolution, reduce its share capital in any manner and subject to any consent required under the provisions of relevant laws and regulations for the time being in force. The provisions of the Ordinance shall be complied with in this regard.
11. Except to the extent permitted by the Ordinance, no part of the funds of the Company shall be employed in the purchase of any shares of the Company, and the Company shall not give, whether directly or indirectly, and whether by means of a loan, guarantee, the provision of security or otherwise, any financial assistance for the purchase of or in connection with a purchase made or to be made by any person of any shares of the Company or give any loan upon the security of any shares of the Company.

**Sub-division or
consolidation of
shares**

**Reduction of
Capital**

**Loans, advances
for and purchase of
company's
shares prohibited**

SHARES

12. Shares may be registered in the name of any individual, limited company or other body corporate but not in the name of a minor, insolvent or person of unsound mind, unless otherwise required under applicable law. Not more than four persons shall be registered as joint-holders of any shares.

Persons in whose name shares to be registered

13. If any share stands in the name of two or more persons, the person first named in the Register shall, as regards receipt of Dividend or services of notice, and all or any other matters connected with the Company except the transfer of shares, be deemed the shareholder.

The first named of joint holders of shares

14. In the case of the death of any one or more of the persons named in the Register as the joint-holders of any share, the survivor or survivors shall be the only person or persons recognized by the Company as having any title to or interest in such share, but nothing herein contained shall be taken to release the estate of a joint-holder from any liability on shares held by him jointly with any other person.

Death of one or more of joint holders of shares

15. Every shareholder shall name to the Company an address and such address shall for all purposes be deemed to be his registered address.

Shareholders to give address

CERTIFICATE

16. Every person whose name is entered as a Member in the Register shall without payment be entitled to receive, after allotment or registration of transfer, one certificate for all his shares or several certificates each for one or more of his shares and upon payment of such charges, if any, as the Directors may determine for every certificate after the first.

Member's right to certificate

17. The certificate of title of shares and duplicates thereof when necessary shall be issued under the Seal of the Company and signed by two Directors, or by one Director and the Secretary.

Certificates

18. The Company shall not be bound to issue more than one share certificate in respect of a share or shares held jointly by two or more persons, and delivery of a share certificate to any one of the joint-holders shall be sufficient delivery to all.

Only one certificate for each share

19. The Company shall, within ninety days, after the allotment of any

Delivery of

of its shares, and within forty five days after the date on which the application for the registration of transfer has been lodged, complete and have ready for delivery the certificates of all shares, allotted or transferred, and shall serve notice to the shareholder, unless the conditions of issue of the shares otherwise provide.

Certificate

20. If any certificate be worn out, defaced, destroyed or lost or if there is no further space on the back thereof for endorsement of transfer, it may be renewed or replaced on payment of such fee, not exceeding five rupees, as the Directors may from time to time prescribe, provided, however, that such new certificate shall not be granted except upon delivery of the worn out or defaced or used up certificate for the purpose of cancellation or upon proof of destruction or loss to the satisfaction of the Directors and on such indemnity as the Directors may deem adequate in case of certificate having been lost or destroyed. Any renewed certificates shall be marked as such.

Replacement of Certificate

21. If and whenever as a result of an issue of new shares or any consolidation or sub-division of shares any Member becomes entitled to hold shares in fraction, the Directors shall not be required to issue such fractional shares and shall be entitled to sell these shares at a reasonable price and pay and distribute to and amongst the Members entitled to such fractional shares in due proportion the net proceeds of the sale thereof.

Proceeds from fractional shares

22. For the purpose of giving effect to any sale under Article 21 the Directors may authorize any person to transfer the shares sold to the purchaser thereof, and the purchaser shall be registered as the holder of the shares comprised in any such transfer, and he shall not be entitled to see the application of the purchase money nor shall his title to the shares be affected by any irregularity or invalidity in the proceedings in reference to the sale.

Sale of whole shares in lieu of fractional amount

COMMISSION AND BROKERAGE

23. The Company may, subject to the Ordinance, at any time, pay commission or brokerage to any person for subscribing or agreeing to subscribe (whether absolutely or conditionally) for any shares or securities of the Company, or procuring or agreeing to procure such subscriptions (whether absolute or conditional).

Commission and Brokerage

24. The Company may issue ordinary shares or grant option to convert into ordinary shares against loans, indebtedness, debenture and/or redeemable capital or other security in the manner provided in the Ordinance.

Shares in lieu of debentures, etc.

TRANSFER AND TRANSMISSION OF SHARES

25. Subject to the provisions of the Ordinance, no transfer of shares shall be registered unless a proper instrument duly stamped and executed by the transferor and the transferee has been delivered to the Company together with the certificate or certificates of the shares. The instrument of transfer of any shares shall be signed both by the transferor and transferee and shall contain the name and address of the transferor and transferee. The transferor shall be deemed to remain the holder of such share until the name of the transferee is entered in the Register in respect thereof. Each signature to such transfer shall be duly attested by the signature of one witness who shall add his address and occupation.
26. Upon the re-lodgement of instruments of transfer duly rectified from defect or the invalidity, the Company shall within forty-five days thereof, register such transfer in favour of the transferee, if satisfied as to the validity of the transfer in all material respects.
27. Application for the registration of shares may be made either by the transferor or the transferee and subject to the provisions of Article 25 hereof, the Company shall enter into the Register the name of the transferee in the same manner and subject to the same condition as if application for registration was made by the transferee.
28. If the Directors refuse to register the transfer of any shares they shall within thirty days from the date on which the transfer was lodged with the Company send to the transferee and the transferor notice of such refusal.
29. Every transmission of share shall, if so required by the Directors, be evidenced by an instrument of transmission in such form and shall be verified in such manner as the Directors may require. The Directors may decline to register any such transmission unless it shall be in such form and so verified and the regulations of the Company complied with. All instruments of transmission which shall be registered shall remain in the custody of the Company for such period as the Directors may determine. Any instrument of transmission which the Directors may decline to register or act upon shall be returned to the person depositing the same.
30. Every instrument of transfer shall be left at the office for registration, duly stamped, accompanied by the certificate of the shares to be transferred and such other evidence as the Company may require to prove the title of the transferor or his right to transfer the shares. All instruments of transfer which will be registered shall be retained by the Company. Any instrument of

Restriction on transfer

Time limit for registering transfer

Notice of refusal to register

Evidence of transmission and powers to refuse registration of transmission

Transfer to be left at office and evidence of title given

transfer which the Directors may decline to register shall, on demand, be returned to the person depositing the same.

31. Where it is proved to the satisfaction of the Directors that an instrument of transfer duly signed by the transferor and the transferee has been lost, the company may, if the Directors shall think fit, by an application in writing made by the transferee and bearing the stamps required by an instrument of transfer, register the transfer on such terms as to indemnify as the Director may think fit.
32. No fee will be charged for registering transfer of shares.
33. The transfer books and Register may be closed for any time or times not exceeding in the whole forty-five days in each year, but not exceeding thirty days at a time, in accordance with the manner specified in the Ordinance.
34. A nominee, if any, appointed under the provisions of the Ordinance, or a legal representative of a deceased member shall be the only person recognised by the Company as having title to his share. In case of joint-holders, the surviving holders or the executors or administrators of the last surviving holder shall be the only person entitled to be so recognised. The Company shall not be bound to recognise such nominee or legal representative except as provided in the Ordinance unless he shall have obtained probate or letters of administration or other legal representation, as the case may be, from a duly constituted court in Pakistan or from any court or authority authorized by an Act of the legislature or by any order or notification of the Central or Provincial Government, to grant such probate or letters of administration. Provided nevertheless that in special cases, and in such cases only, it shall be lawful for the Directors to dispense with the production of probate or letters of administration or such other legal representation upon such terms as to indemnity or otherwise as the Directors may deem fit.
35. The Company shall incur no liability or responsibility whatsoever in consequence of their registering or giving effect to any transfer of shares made or purporting to be made by an apparent legal owner thereof to the prejudice of persons having or claiming any equitable right, title or interest to or in the same notwithstanding that the Company may have had notice of such equitable right, title or interest, or notice prohibiting registration of such transfer, and may have entered such notice or referred thereto in any book of the Company and shall not be bound or required to attend, or give effect to any notice, which may be given to them of any equitable right, title or interest or be under any liability whatsoever for

Registration of transfer when instrument of transfer is lost

Fee for transfer

Books and register may be closed

Nomination and share of deceased members

Company may not recognize equitable rights in shares

refusing or neglecting so to do, though it may have been entered or referred to in some book of the Company. The Company shall nevertheless be at liberty to regard and attend to any such notice and give effect thereto if the Directors shall so think fit.

GENERAL MEETINGS

36. A general meeting to be called the annual general meeting shall be held, in accordance with the provisions of the Ordinance, within eighteen months from the date of incorporation of the Company and thereafter once at least in every calendar year within a period of four months following the close of its financial year and not more than fifteen months after the holding of its last preceding annual general meeting and shall be held on the date, and at the time and place as may be determined by the Directors. Any meeting of the Members of the Company, other than an annual general meeting, shall be called an Extraordinary General Meeting.
37. The statutory meeting of the Company shall be held in the manner, for the purpose and within the period required by the Ordinance.
38. The Directors may, whenever they think fit, and shall on the requisition of the holders of not less than 10% of the issued capital of the Company, forthwith proceed to convene an Extraordinary General Meeting of the Company and in case of such requisition, the provisions of the Ordinance shall apply.

General meeting

Statutory Meeting

**When an
extraordinary
meeting to be called**

NOTICE OF MEETING

39. Subject to the provisions of the Ordinance twenty-one days notice at least (exclusive of the day on which the notice is served or deemed to be served, but inclusive of the day for which notice is given) specifying the place, the day and the hour of meeting shall be given in respect of a general meeting. In case of special business the general nature of that business shall be given in the manner hereinafter provided or in such other manner, if any, as may be prescribed by the Company in general meeting or in the manner provided by the Ordinance, to such persons as are under the Ordinance or under these Articles, entitled to receive such notice from the Company.
40. An accidental omission to give notice of a meeting to or the non-receipt of notice of a meeting, by any person entitled to receive notice shall not invalidate the proceedings of the meeting.
41. With the consent in writing of all the Members entitled to receive notice of a particular meeting, that meeting may be convened by

Notice of Meeting

**Omission to give
notice not to
invalidate
proceedings**

**Meeting by a
shorter notice**

such shorter notice and in such manner as those Members may deem fit subject to approval by the Registrar on application made by the Directors.

PROCEEDINGS AT GENERAL MEETINGS

42. The business of an annual general meeting shall be to receive and consider the financial statements and the reports of the Directors and of the auditors, to elect Directors, to declare Dividends and to appoint auditors and fix their remuneration. All other business transacted at an annual general meeting and all business transacted at an extraordinary general meeting, shall be deemed special.
43. No business shall be transacted at any general meeting unless a quorum of meeting is present at the time when the meeting proceeds to business and throughout its proceedings. Subject to the provisions of the Ordinance, four Members present personally or by proxy at the meeting and representing in the aggregate not less than twenty five percent of the total voting power of the Company shall be a quorum.
44. If within half an hour from the time appointed for the meeting a quorum is not present, the meeting shall stand adjourned to a date, time and place to be determined and at the adjourned meeting the Members present being not less than two Members shall be a quorum.
45. The Chairman if any, of the Board of Directors shall preside as Chairman at every general meeting of the Company, or if there is no such Chairman, or if he shall not be present within fifteen minutes after the time appointed for the holding of the meeting or is unwilling to act, the Directors present shall elect one of their member to be Chairman of the meeting, or if no Director be present or if Directors present decline to take the chair, the Members present shall choose one of their number to be Chairman of the meeting.
46. The Chairman may with the consent of any meeting at which a quorum is present (and shall if so directed by the meeting), adjourn the meeting from time to time and from place to place, but no business shall be transacted at any adjourned meeting than the business left unfinished at the meeting from which the adjournment took place.
47. At a general meeting, a resolution put to the vote shall be decided on a show of hands, unless a poll is (before or on the declaration of the show of hands) demanded in accordance with the applicable provisions of the Ordinance as follows:

Special Business

Quorum

Quorum within half an hour

Chairman to preside

Adjournment by Chairman

Poll when demanded

- a) by the Chairman of the meeting of his own motion; or
- b) by at least five Members having the right to vote on the resolution and present in person or proxy;
- c) by any Member or Members present in person or by proxy and having not less than one-tenth of the total voting power in respect of resolution; or
- d) by any Member or Members present in person or by proxy and holding shares in the Company conferring a right to vote on the resolution, being shares on which an aggregate sum has been paid up which is not less than one-tenth of the total sum paid up on all the shares conferring that right.

Unless a poll is so demanded, a declaration by the Chairman of the meeting that a resolution has on a show of hands been carried or carried unanimously or by a particular majority, or lost, and an entry to that effect in the book containing the minutes of the proceedings of the Company, shall be conclusive evidence of the fact without proof of the number or proportion of the votes recorded in favour of or against such resolution.

48. If a poll is demanded on any matter other than the election of a Chairman or on a question of adjournment, it shall be taken in accordance with the manner laid down in the Ordinance at such time, not more than fourteen days from the day on which it is demanded, as the Chairman of the meeting may direct.

Poll

The results of the poll shall be deemed to be the resolution of the meeting at which the poll was demanded. The demand for a poll may be withdrawn at any time by the person or persons who made the demand.

49. The demand of a poll shall not prevent the continuance of the meeting for the transaction of any business other than the question on which the poll has been demanded.

**Other business
to continue**

50. The Chairman of any meeting shall be the sole judge of the validity of every vote tendered at such meeting. The Chairman present at the taking of poll shall be the sole judge of the validity of every vote tendered at such poll.

**Chairman's decision
conclusive**

VOTES OF MEMBERS

51. On a poll every Member present in person or by proxy shall have one vote in respect of each share held by him. On a show of hands every Member present in person or by proxy shall have one vote.

**Votes of
members**

52. In the case of joint-holders the vote of the senior Member present whether in person or by proxy shall be accepted to the exclusion of the votes of the other joint-holders, and for this purpose seniority shall be determined by the order in which their names stand in the Register.

**Rights of senior
members to vote**

53. A Member of unsound mind, or in respect of whom an order has been made by any court having jurisdiction in lunacy, may vote, whether on a show of hands or on a poll, by his committee or other legal guardian and any such committee or guardian may, on a poll, vote by proxy.

**Vote in respect of
shares of
members of unsound
mind**

54. No objection shall be raised to the qualification of any vote except at the meeting or adjourned meeting at which the vote objected to is given or tendered, and every vote not so objected to at such meeting shall be valid for all purposes. Any such objection made in due time shall be referred to the Chairman of the meeting whose decision shall be final and conclusive.

**Objection to
qualification of
votes to be
raised at the
meeting**

55. On a poll, votes may be given either personally or by proxy.

**How votes to be
given on a poll**

56. The instrument appointing a proxy shall be in writing under the hand of the appointer or of his attorney duly authorized in writing, or, if the appointer is a body corporate, corporation or company, either under its common seal or under the hand of an officer or attorney duly authorized.

**Instrument of
proxy how made**

57. The instrument appointing a proxy and the power of attorney or other authority (if any) under which it is signed or a notarially certified copy of that power or authority shall be deposited at the office not less than forty-eight hours before the time for holding the meeting at which the person named in the instrument proposes to vote, and in default the instrument of proxy shall not be treated as valid.

**Time for
depositing
proxy at office**

58. An instrument appointing a proxy may be in the following form, or in any other form which the Directors shall approve:

Form of proxy

I/We _____ S/o, D/o, W/o _____
of _____
being a member of **Mirpurkhas Energy Limited**

(the Company) and holder of _____ Shares as per Share Register Folio No. _____ hereby appoint _____

(Name)

of _____
(full address)

or failing him/her _____
(Name)

of _____
(full address)

as my /our proxy to attend, speak and vote for me/us and on my/our behalf, at the _____ Annual General Meeting / Extra Ordinary General Meeting of the Company to be held on _____, at _____ and at any adjournment thereof.

As witnessed given under my/our hand(s) _____ day of _____.

1. **Witness:**
Signature _____
Name _____
NIC No. _____
Address _____

Atlix Revenue
Stamp

Signature of Members

2. **Witness:**
Signature _____
Name _____
NIC No. _____
Address _____

Shareholder's Folio No. _____
NIC No. _____
Dated: _____

59. The instrument appointing a proxy shall be deemed to confer authority to demand or join in demand for a poll.

Effect of proxy

60. A vote given in accordance with the terms of an instrument of proxy shall be valid notwithstanding the previous death or insanity of the principal or revocation of the proxy or of the authority under which the proxy was executed, or the transfer of the shares in respect of which the proxy is given, provided that no intimation in writing of such death, insanity revocation or transfer, as aforesaid shall have been received by the Company at the office before the commencement of the meeting or adjourned meeting at which the proxy is used.

**When vote by
proxy valid though
authority revoked**

61. Any corporation or body corporate which is a Member of the Company may by resolution of its Directors or other governing body authorize such person as it thinks fit, to act as its representative at any meeting of the Company or of any class of members of the Company and the persons so authorized shall be entitled to exercise the same powers on behalf of the corporation which he represents as that corporation could exercise if it were an

**Member
Corporation
may appoint
representative**

individual member of the Company, present in person. A corporation attending a meeting through such representative shall be deemed to be present at the meeting in person.

DIRECTORS

62. The number of Directors to be elected shall be fixed according to the provisions of the Ordinance subject to the condition that until otherwise determined, the number of Directors to be elected in accordance with the provisions of the Ordinance shall not be less than three and more than twelve. In addition to the Directors elected or deemed to have been elected by shareholders, the Company may have, subject to the provisions of the Ordinance, Directors nominated by the Company's creditors or other special interest by virtue of contractual arrangements.

**Number of
directors**

63. The following shall be the first Directors of the Company:

First Directors

- | | |
|----------------------|-------------------------|
| 1. Mr. Aslam Faruque | 2. Mr. Shehryar Faruque |
| 3. Mr. Tariq Faruque | 4. Mr. Abid Akber Vazir |
| 5. Mr. Yasir Masood | 6. Mr. Wasif Khalid |

All the first Director(s) who are subject to retirement in terms of the provisions of the Ordinance shall hold office until the election of Directors in the first annual general meeting unless any of them earlier resigns, becomes disqualified as a Director or otherwise ceases to hold office.

64. Notwithstanding the provision of these Articles, the appointment, election, tenure of office and removal of Directors shall be made and/ or carried out in accordance with provisions of the Ordinance. Subject to the provision of the Ordinance the Directors shall be elected by the Members in general meeting from amongst the candidates eligible for election in the following manner:

Election of directors

- a) Every member present in person or by proxy or by representative shall have such number of votes as is equal to the product of the number of voting shares held by him and the number of Directors to be elected;
- b) The number of votes calculated in accordance with the preceding clause (a) may be given to a single candidate or may be divided between any two or more candidates in such manner as the person voting may choose; and
- c) The candidate who gets the highest number of votes shall be declared elected as Director and then the candidate who gets the next highest number of votes shall be so declared

and so on until the total number of Directors to be elected has been so elected.

65. Any person who seeks to contest an election to the office of Director shall, whether he is a retiring Director or otherwise, file with the Company, not later than fourteen days before the date of meeting at which elections are to be held, a notice of his intention to offer himself for election as a Director, provided that any such person may, at any time, before the holding of elections withdraw such notice.
66. Save as provided in the Ordinance, no person shall be appointed as a Director unless he is a Member of the Company.
67. Retiring Directors shall continue to perform their functions until their successors are elected.
68. A Director elected by the Members in a general meeting shall hold office for a period of three years following the date from which his election is effective unless he earlier resigns, becomes disqualified for being a Director or otherwise ceases to hold office.
69. The remuneration of a Director for attending the meetings of the Board shall, from time to time be determined by the Board. The Directors shall be paid such travelling, boarding, lodging and other expenses properly incurred by them in or about the performance of their duties or business if any of them has to come to attend the Board or general meeting of the Company from outstation.
70. Any Director appointed to any executive office including for the purpose of this Article the office of Chief Executive, Chairman, or to serve on any Committee or to devote special attention to the business of the Company or who otherwise performs extra services, which in the opinion of the Directors are outside the scope of the ordinary duties of the Directors, may be paid such extra remuneration by way of salary, fees, percentage of profits or otherwise as shall from time to time be determined by the Board of Directors and be subject to provisions of any law for the time being in force applicable to the Company.
71. Subject to the provisions of the Ordinance, the Company may at any time, by resolution in general meeting, remove a director, appointed under the applicable provisions of the Ordinance or elected in the manner provided for in the Ordinance but no such resolution shall be deemed to have been passed if the number of votes cast against it is equal to or exceeds:

Notice for election as a director

Directors to be members

Retiring directors continue to perform functions

Term of office of director

Remuneration of a director

Special remuneration to directors for performing extra duties

Removal of director

- (a) the minimum number of votes that were cast for the election of such Director at the immediately preceding election of Directors, if the resolution relates to the removal of Director elected under sub-section (5) of Section 178 of the Ordinance; or
- (b) the total number of votes for the time being computed in the manner laid down in sub-section (5) of Section 178 of the Ordinance divided by the number of Directors for the time being, if the resolution relates to removal of director appointed under Section 176 or Section 180 of the Ordinance.

72. Any casual vacancy occurring among the elected Directors may be filled up by the Directors, but a person so appointed in lieu of an elected Director shall hold office for the remainder of term of the Director in whose place he is appointed. Before filling in any casual vacancy on the Board, the Directors, shall in writing notify their intention of filling such vacancy to the Member or Members, if any, whose interest were represented by the Director vacating office and shall fix a term of not less than fourteen clear days during which such Member or Members may recommend (jointly if there are two or more Members) a candidate for appointment as Director to fill such vacancy. If the Member or Members concerned recommend a candidate in writing within the term prescribed, the Directors may appoint him as Director to fill the casual vacancy but upon such recommendation being made no person, other than the candidate recommended by such Member or Members, may be appointed by the Directors to fill the casual vacancy on the Board.

**Casual vacancy to
be filled by
directors**

73. Any Director who intends to be, or is absent for a period of not less than three (3) months from Pakistan, may with the approval of the Board (such approval not to be unreasonably withheld) nominate any person to be his alternate Director. Particulars of such nomination should be filed with the Secretary of the Company. Such alternate Director during the absence of the appointer from Pakistan shall be entitled to receive notice of and to attend and vote at meeting of Directors and shall be subject to the provisions contained in these Articles. He may exercise and perform all such powers, directions and duties as his appointer could have exercised or performed including the power of appointing another alternate Director. An alternate Director so appointed shall not be entitled to receive any remuneration from the Company nor be required to hold any qualification shares. Such appointment shall be recorded in the Directors minutes book. A Director may at any time by notice in writing to the Company remove an alternate Director appointed by him upon his return to Pakistan, or on the death of, or

Alternate director

retirement or resignation as Director of the Company, the alternate Director shall cease to be an alternate Director provided that if any Director retires but is re-elected at the meeting at which such retirement took effect, an appointment made by him pursuant to this Article which was in force immediately prior to his retirement and re-election and which has not otherwise ceased to be effective, shall continue to operate after his re-election as if he had not so retired. An alternate Director shall not be deemed to be the agent of the Director appointing him but shall be reckoned as one with his appointer. All appointments and removals of alternate Directors shall be effected by writing under the hand of the Director making or revoking such appointment and left at the office of the Company. For the purpose of assessing a quorum in accordance with the provisions of Article 88 hereof, an alternate Director shall be deemed to be a Director. Any Director may act as an alternate Director for any one or more Directors, as well as being able to act as a Director in his own right. An alternate Director may resign as such upon giving thirty (30) days prior notice in writing to the Board to this effect. An alternate Director need not be a Member of the Company.

74. The Company may have Directors nominated by any financial institution or a bank or consortium (hereinafter called institution). Where such institution requires appointment of its nominee as a Director under the terms of granting loans, redeemable capital, subscribing to the Company's debentures or debenture-stock, making bridge financing, or under stipulations that a loan granted shall be converted into shares at the option of either party to the contract or otherwise, such Director shall act as a Director at the pleasure of the institution appointing him. Such Director may be called "Institutional Director" or "Creditor Director" or prefixed by the name of nominating institution. Such Director shall neither be required to hold any qualification shares nor shall be subject to the provisions relating to retirement, removal, qualification, disqualification of Directors, but shall have the same rights and privileges and be subject to the same obligations as other Directors of the Company. Institutions nominating a Director may require withdrawal or removal of such Director or upon resignation or death of such Director, such institutions shall have the right to nominate another person in his place.

**Nominated
Directors**

75. The Directors shall elect from amongst themselves from time to time a Chairman of the Board. In the event the position of Chairman falls vacant or he is held by the Board as not being able to carry out the duties of his office satisfactorily, the Board shall revoke his appointment and appoint another Director to be the Chairman of the Board. The Chairman of the meeting of Directors shall be the sole judge of the validity of every vote tendered at

Chairman

such meetings.

76. The Directors may from time to time delegate any of their powers to a committee or committees consisting of three or more members of their body as they think fit. Any committee so formed shall conform to any regulations that may be imposed upon it by the Directors and shall be governed, in the exercise of the powers so delegated, by the provisions herein contained for regulating meeting and proceedings applicable to the Directors.

**Executive
committee of
directors**

POWERS AND DUTIES OF DIRECTORS

77. The business of the Company shall be managed by the Directors, who may pay all expenses incurred in setting up and registering the Company. The Directors may exercise all such powers of the Company as are not by the Ordinance or any statutory modification thereof for the time being in force, or by any other law or these Articles, required to be exercised by the Company in general meeting. But no regulation made by the Company in general meeting shall invalidate any prior act of the Directors which would have been valid if that regulation had not been made.

**General powers
of directors**

78. The Directors may subject to any limitation or restrictions as they may deem fit to impose from time to time exercise all the powers of the Company to borrow money and to mortgage or charge its undertaking, property, or any part thereof, and to issue securities and debentures whether outright or as security for any debt, liability or obligations of the Company or of any third party.

**Borrowing powers
of directors**

79. The Directors may from time to time and at any time by power of attorney appoint any company, firm or person or body of persons, whether nominated directly or indirectly by the Directors, to be the attorney or attorneys of the Company for such purposes and with such powers, authorities and discretion (not exceeding those vested in or exercisable by the Directors under these Articles) for such period and subject to such conditions if any as they may think fit. The powers of attorney may contain such provisions for the protection and convenience of persons dealing with any such attorney to delegate all or any of the powers, authorities and discretion vested in him.

**Power to appoint
attorneys**

80. A Director of the Company or a firm of which such Director is a partner or a private company in which such Director is a Director or member may with the consent of the Company in general meeting hold any office of profit in the Company.

**Directors may hold
office of profit**

81. Subject to the provisions of the Ordinance, the Directors shall not

Directors may

be disqualified from contracting with the Company either as vendor, purchaser, or otherwise, nor shall any such contract or agreement entered into by or on behalf of the Company with any company or partnership in which any Director of the Company shall be a member or otherwise interested be voided nor shall any such Director so contracting or being such member or so interested, be liable to account to the Company for any profit realized by any such contract or arrangement by reason of such Director holding that office or of the fiduciary relation thereby established. However, the nature of his interest shall be disclosed by him at the meeting of the Directors at which the contract or arrangement is determined on, if the interest then exists, or in any other case at the first meeting of the Directors after the acquisition of the interest. A general notice that any Director of the Company is a Director or a member of any other company or is a member of any named firm and is to be regarded as interested in any subsequent transaction with such company or firm shall as regards any such transaction be sufficient disclosure under this Article. Subject to the provision of the Ordinance, after any such general notice it shall not be necessary to give any special notice relating to any particular transaction with such firm or company. In the case of a contract for the appointment of a manager of the Company, the applicable provisions of the Ordinance shall be observed and performed.

**make contract
with the
Company**

82. In accordance with the provisions of the Ordinance, a Register shall be kept by the Directors in which shall be entered particulars of all contracts or arrangements to which Article 81 applies and which shall be open to inspection by any Member at the Office during business hours.

**Register of contract
with directors**

83. All cheques, promissory notes, drafts, bills of exchange and other negotiable instruments, and all receipts for moneys paid to the Company, shall be signed, drawn, accepted, endorsed or otherwise executed, as the case may be, in such manner as the Directors shall from time to time by resolution determine.

**Manner of
signing certain
documents**

84. The Directors shall duly comply with the provisions of the Ordinance or any statutory modification thereof for the time being in force, in particular with the provisions in regard to the registration of the particulars of mortgages and charges affecting the property of the Company or created by it. The Directors shall keep a register of the Directors and managers and send to the Registrar all returns and statements required under the Ordinance, and in particular an annual list of Members and a summary of particulars relating thereto and notice of any consolidation or increase of share capital, or conversion of shares into stock and copies of special resolutions and a copy of the register of Directors,

**Directors to
comply with the
law**

officers, chief executive, secretary, chief accountant, auditors and legal advisers and any changes therein.

85. The Directors shall cause minutes to be made in books provided for the purpose :

**Directors to
cause minute
books to be
maintained**

- a) of all appointments of officers made by the Directors;
- b) of the names of the Directors present at each meeting of the Directors and of a committee of Directors;
- c) of all resolutions and proceedings of all meetings of the Company, and of the Directors and of a committee of Directors;

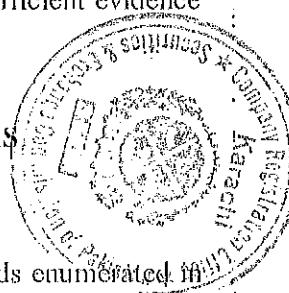
and every Director present at any meeting of Directors or committee of Directors shall sign his name in a book to be kept for the purpose. Any such minutes of such a meeting if purporting to be signed by the Chairman thereof, or by the Chairman of the next succeeding meeting of the same body, shall be sufficient evidence without any further proof of the fact therein stated.

DISQUALIFICATION OF DIRECTORS

86. The office of Director shall be vacated if:

- a) he is ineligible on any one or more grounds enumerated in Section 187 of the Ordinance;
- b) he absents himself from three consecutive meetings of the Directors or from all meetings of the Directors for a continuous period of three months whichever is the longer without leave of absence from the Board of Directors;
- c) he or any firm of which he is a partner or any private company of which he is a director without the sanction of the Company in general meeting accepts or holds any office of profit under the Company other than that of chief executive or a legal or technical adviser or a banker;
- d) he is found to be of unsound mind by a court of competent jurisdiction;
- e) he is adjudged an insolvent;
- f) he acts in contravention of Section 195 of the Ordinance;

**Vacation of
office of director**



- g) he has been convicted by the Court of competent jurisdiction for an offence involving moral turpitude;
- h) he resigns his office by notice in writing to the Company;
- i) he has betrayed lack of fiduciary behavior and a declaration to this effect has been made by the Court under Section 217 of the Ordinance;
- j) he has been declared by a Court of competent jurisdiction as defaulter in repayment of loan to a financial institution, exceeding such amount as may be notified by the Securities and Exchange Commission of Pakistan from time to time;

PROCEEDINGS OF DIRECTORS

87. The Directors may meet together for the dispatch of business, adjourn or otherwise regulate their meetings, as they think fit. A Director may, and the Secretary, on the requisition of a Director shall, at any time, summon a meeting of Directors. It shall not be necessary to give notice of meeting of Directors to any Director for the time being absent from Pakistan.

Directors may regulate meetings

88. The quorum necessary for the transaction of the business of the Directors may be fixed by the Company in general meeting and unless so fixed shall be not less than one-third of the number of Directors for the time being or four whichever be higher. For the purposes of this Article, an alternate Director appointed by a Director shall be counted in a quorum at a meeting at which the Director appointing him is not present.

Quorum

89. All questions arising at any meeting of Directors shall be decided by a majority of votes. In the case of an equality of votes, the Chairman of the meeting shall have a second or casting vote.

Matters to be decided by majority vote

90. The continuing Directors may act notwithstanding any vacancy in their body, but if and so long as their number is reduced below the number fixed by or pursuant to the regulations of the Company as the necessary quorum of Directors, the continuing Directors may act for the purpose of filling vacancies in their body or summoning a general meeting of the Company, but for no other purpose.

Procedure of continuing directors when there are vacancies to be filled

91. All acts done at any meeting of the Directors or by any person acting as a Director notwithstanding that it shall afterwards be discovered that there was some defect in the appointment or continuance in office of any such Director or person acting as aforesaid, or that they or any of them were disqualified or had

Acts of directors to be valid if defect discovered afterward

vacated office, or were not entitled to vote, be as valid as if every such person had been duly appointed or had duly continued in office and were qualified and had continued to be a Director and had been entitled to be a Director.

92. Subject to the provisions of the Ordinance, a resolution consented to in writing or by e-mail, telex, telegram or facsimile signed by all of the Directors or their alternatives, shall be as valid and effectual as if it has been passed at a meeting of the Directors duly called and constituted. The consent may be in the form of counterparts.

**Resolution by
circulation**

93. Subject to any rules framed under or any regulations or directives issued pursuant to the Ordinance, the Directors or members of a committee of Directors may take part in a meeting of the Directors or a committee by using any communication equipment which allows everybody participating in the meeting to speak to and hear each other. Taking part in this way will count as being present at the meeting in person. Meetings will be treated as taking place where the largest group of the participants are or, if there is no such group, where the Chairman of the meeting is.

**Directors meeting
through audio/video
conferencing**

94. If the Chairman is absent at any meeting of the Board of Directors, the Directors present may elect any Director to act as the Chairman of the meeting.

**Election of
Chairman for
the meeting**

CHIEF EXECUTIVE

95. The Directors shall within fourteen days of the constitution of the Board or from the date of election of Directors or the office of the Chief Executive falling vacant, as the case may be, appoint, subject to the provisions of the Ordinance, a Chief Executive of the Company, for a period of three years. The Board may revoke such appointment and appoint another person in place of the Chief Executive so removed or who may vacate office by reason of death, resignation or otherwise as the case may be.

**Company to have
Chief Executive**

96. (a) The period for which the Chief Executive shall be appointed shall not exceed three years unless he ceases to hold office or a shorter time of appointment is fixed by the Directors, or he earlier resigns or his services as Chief Executive have been terminated by the Board in accordance with the provisions of the Ordinance. On the expiry of his term of office, the Chief Executive shall be eligible for re-appointment in the manner provided in these Articles or in accordance with the provisions of the Ordinance. The terms and conditions of appointment of the Chief Executive, including his powers, duties, obligations and remuneration, shall be determined by

**Tenure of Chief
Executive and terms,
conditions, powers
and duties of the
Chief Executive**

the Board, subject to the provisions of the Ordinance and these Articles.

- (b) The Board shall have the powers to assess the performance of the Chief Executive every year and shall replace the Chief Executive, if his performance is found unsatisfactory in the opinion of the Board.
- (c) The Chief Executive shall hold office, enjoy and exercise such powers, duties, obligations and privileges as the Board may confer upon him from time to time and shall accordingly in exercise of such powers delegated to him, conform to any limits and restrictions which may be imposed by the Board from time to time in this respect. The Chief Executive may exercise all such powers and do all acts and things on behalf of the Company as he may be authorized to do by the Board.

97. The Chief Executive shall be entitled to remuneration and benefits commensurate with his performance, which determination shall be made by the Board.

**Emoluments of
the Chief Executive**

98. The Chief Executive may be removed in accordance with the provisions of the Ordinance.

**Removal of
Chief Executive**


SECRETARY

99. A Secretary may be appointed by the Directors for such term, at such remuneration and upon such conditions as they may think fit, and any Secretary so appointed may be removed by them. Where there is no Secretary capable of acting, the Directors may appoint an assistant or deputy Secretary or any other officer of the Company to perform the duties of Secretary.

Secretary

THE SEAL

100. The Directors shall provide for the safe custody of the Seal which shall only be used by the authority of the Directors, and every instrument to which the Seal shall be affixed shall either be signed by one Director and countersigned by the Secretary or by a second Director or by some other person authorized by the Directors for the purpose.

**Common Seal of
the Company**

DIVIDENDS AND RESERVES

101. The Company in general meeting may declare a Dividend, but no Dividend shall exceed the amount recommended by the Directors. **Company may declare a Dividend**
102. No Dividend shall be paid by the Company otherwise than out of profits or reserves of the Company or in contravention of the Ordinance. **Dividend Payable from Profits only**
103. The Directors may from time to time pay to the Members such interim Dividend as appear to the Directors to be justified by the profits of the Company. **Interim dividend**
104. The profits of the Company available for appropriation/distribution after making such provisions and transfers to reserve as shall be required to meet expenses or anticipated expenses of the Company, subject to the provisions of the Ordinance, may be appropriated and distributed periodically and/or annually by way of Dividend, subject to the development needs and liquidity position of the Company as recommended/determined by the Board, in full to the Members of the Company in proportion to their respective shareholding. **Reserve fund**
105. When any shareholder is indebted to the Company, all Dividends payable to him or a sufficient part thereof, may be retained and applied by the Directors in or towards satisfaction of the debt. **Dividends to shareholder, indebted to the company**
106. Any Dividend, interest or other moneys payable in cash in respect of shares may be paid by cheque or warrant sent through the post direct to the registered address of the holder or, in the case of joint-holders, to the registered address of that one of the joint-holders who is first named in the Register or to such persons and to such address as the holder or joint-holders may in writing direct. Every such cheque or warrant shall be made payable to the order of the person to whom it is sent. Any two or more joint-holders may give effectual receipt for any Dividends or other moneys payable in respect of the shares held by them as joint-holders. The Dividend shall be paid within the period laid down in the Ordinance. **Payment of Dividends**
107. Unpaid Dividends shall not bear interest against the Company. **Unpaid Dividend shall not bear interest**

CAPITALIZATION OF PROFITS

108. The Company in general meeting may upon the recommendation of the Directors resolve that it is desirable to capitalize any part for **Capitalization of**

the time being of the Company's reserves or accumulated profits otherwise available for distribution, and accordingly that such sum be set free for distribution amongst the Members who would be entitled thereto if distributed by way of Dividend and in the same proportion and on the condition that the same be not paid in cash but be applied in paying up in full un-issued shares as bonus shares of the Company to be allotted and distributed/credited as fully paid up to and amongst such Members in the proportion aforesaid, or partly in one way and partly in the other, and the Directors shall give effect to such resolution.

profits

ACCOUNTS

109. The Directors shall cause proper books of account to be kept as required by the Ordinance.
110. The books of account shall be kept at the Office of the Company or at such other place as the Directors shall deem fit and shall be open to inspection by the Directors during business hours.
111. The Directors shall from time to time determine whether and to what extent and at what time and place and under what conditions or regulations the accounts and books or papers of the Company or any of them shall be open to the inspection of Members not being Directors, and no Member (not being a Director) shall have any right of inspecting any account and book or papers of the Company except as conferred by law or authorized by the Directors or by the Company in general meeting.
112. The Directors shall, as required by the applicable provisions of the Ordinance, cause to be prepared and to be laid before the Company in general meeting its duly audited financial statements and reports as may be required under the Ordinance.
113. The financial statements and other reports referred to in Article 112 shall be made out in every year and laid before in the Company's annual general meeting made up to a date not more than four months before such meeting. The financial statements shall be accompanied by a report of the auditors of the Company and the report of Directors.
114. The financial statements shall be audited by the auditors of the Company and shall subject to the provisions of the Ordinance be accompanied by a report of the Directors as to the state and condition of the Company, and as to the amount which they recommend to be paid out of the profits by way of Dividends to the Members, and the amount, if any, which they propose to carry to one or more reserves according to the provisions in that behalf

Books of account

**Location of
books of account**

**Inspection of
books of
account**

**Preparation of
financial
statements and
reports**

**Presentation of
financial
statements and
report before the
general meeting**

Directors' reports

herein contained. Every report of the Directors, shall be signed by the Directors in accordance with the applicable provisions of the Ordinance.

115. A copy of the financial statements together with reports of Directors and auditors shall, atleast twenty one days preceding the annual general meeting, be sent to the persons entitled to receive notices of general meetings, in the manner in which notices are to be given hereunder and a copy thereof shall be deposited at the Office of the Company for the inspection of Members for a period of twenty one days prior to such meeting.

Copy of balance sheet and reports to be served on registered holder

116. The financial statements and reports mentioned in Article 112 above may be transmitted to the Members through email subject to requirements or conditions as may be prescribed by the Securities and Exchange Commission of Pakistan from time-to-time.

Transmission of accounts by e-mail

AUDIT

117. Auditors shall be appointed and their duties regulated in accordance with of the application provisions of the Ordinance.
118. Any of the Directors may at his sole cost and expense, inspect any books of account or document (save and except any documents containing secret information which the Company is under any obligation not to divulge or disclose to any party) and cause to conduct an independent audit of the Company upon giving 10 (ten) days prior notice to the Board and any report arising from such audit shall be distributed to all Directors of the Company.

Auditors

NOTICES

119. A notice may be given by the Company to any Member either personally or by sending it by post, courier, e-mail, telefax or telex to his registered address. Where a notice is sent in any manner aforesaid, service of the notice shall be deemed to be effected by properly addressing, prepaying and posting, delivering, transmitting, as the case may be, a letter containing the notice and unless the contrary is proved, to have been effected at the time at which the letter would be delivered in the ordinary course of post/delivery.
120. A notice may be given by the Company to the joint-holders of a share by giving the notice to the joint-holder named first in the Register in respect of the share and a notice so given shall be sufficient notice to all the holders of such shares.

How notice to be served on members

Notice to joint holders

121. A notice may be given by the Company to the persons entitled to a share in consequence of the death or insolvency of a Member through the post in a prepaid letter addressed to them by name or by the title or representatives of the deceased, or assignee of the insolvent or by any like description, at the address (if any) in Pakistan supplied for the purpose by the persons claiming to be entitled, or (until such an address has been so supplied) by giving the notice in any manner in which the same might have been given if the death or insolvency had not occurred.

**Notice to persons
entitled by
transmission**

122. Notice of every general meeting shall be given in the manner hereinbefore authorized to (a) every Member of the Company, except those Members who have no registered address or have not supplied to the Company an address for the giving of notice to them, and also (b) every person entitled to a share in consequence of the death or insolvency of a Member who but for his death or insolvency would be entitled to receive notice of the meeting.

**Notice of
general meeting**

123 (1) Subject to the provisions of the Ordinance, if the Company is wound up, the liquidator may, with the sanction of a Special Resolution of the Company and any other sanction required by the Ordinance, divide amongst the Members, in specie or kind the whole or any part of the assets of the Company, whether they consist of property of the same kind or not.

Division of assets

(2) For the purpose aforesaid, the liquidator may set such value as he deems fair upon any property to be divided as aforesaid and may determine how such division shall be carried out as between the Members or different classes of Members.

(3) The liquidator may, with the like sanction vest the whole or any part of such assets in trustees upon such trusts for the benefit of the contributories as the liquidator, with the like sanction, thinks fit, but so that no Members shall be compelled to accept any shares or other securities whereon there is any liability.

124. Save as otherwise provided in the Ordinance no Member or other person (not being a Director) shall be entitled to visit and inspect any of the Company's premises or properties of the Company without the permission of the Directors or any person authorized in this behalf by the Directors or to require discovery of or information respecting any detail of the Company's trading or any matter whatsoever which may relate to the conduct of the business of the Company and which in the opinion of the Directors will be expedient in the interest of the Members to be communicated to the public.

Secrecy

DISPUTE RESOLUTION

125. In the event that a dispute, claim or controversy arises between the Company, its management or its Members, or between the Members inter-se, or the Directors inter-se, all steps shall be taken to settle the dispute and resolve the issue through mediation by an accredited mediator before taking recourse to formal dispute resolution such as arbitration or litigation.

Dispute Resolution

INDEMNITY

126. Every Director or officer of the Company and every person employed by the Company as auditors shall be indemnified out of the funds of the Company against all liability incurred by him as such Director, officer or auditor in defending any proceedings, whether civil or criminal, in which judgement is given in his favour, or in which he is acquitted, or in connection with any application under Section 488 of the Ordinance in which relief is granted to him by the court or otherwise permitted by law.

Indemnity

ARBITRATION

127. Whenever any difference arises between the Company on the one hand, and any of the Members, their executors, administrators, or assigns on the other hand, touching the true intent or construction, or the incidents or consequences of these presents, or of the statutes, or touching anything then or thereafter done, executed, omitted or suffered in alleged breach of these presents, or any claim on account of any such breach or alleged breach, or otherwise relating to the premises, or to these presents, or to any statute affecting the Company, or to any of the affairs of the Company, every such difference shall be referred under the Arbitration Act 1940, to the decision of an arbitrator to be appointed by the parties in difference, or if they cannot agree upon a single arbitrator, to the decision of three arbitrators, of whom one shall be appointed by each of the parties in difference, and a third arbitrator or an umpire to be appointed by the two arbitrators. The cost of, and incident to, any such reference and award shall be in the discretion of the arbitrators, or umpire respectively, who may determine the amount thereof, or direct the same to be taxed as between attorney and client or otherwise, and may award by whom, and to whom, and in what manner the same shall be borne and paid.

Arbitration

MISCELLANEOUS

128. If the provisions of these Articles are in any way inconsistent with the provisions of the Ordinance or any other law for the time being in force, the provisions of the Ordinance or that other law shall prevail, and these Articles shall be read subject to the Ordinance or that other law.

**Companies
Ordinance to
prevail**



22/11/16

We, the several persons whose names and addresses are hereunder subscribed, are desirous of being formed into a Company, in pursuance of these **Articles of Association**, and we respectively agree to take the number of shares in the capital of the Company set opposite our respective names:

Name and surname with father's/husband's name (present & former name) in full and block letter	Nationality with any former nationality	Occupation	Residential address in full	Number of shares taken by each subscriber	Signature
Mirpurkhas Sugar Mills Ltd. CUNL 0001893 Holding Company (through Abid Akber Vazir)	Pakistani	Business	2 nd Floor, Modern Motors House, Beaumont Road, Karachi	91 (ninety-four)	
Mr. Aslam Faruque S/o. (Late) Zahid Faruque CNIC # 42301-6351391-7	Pakistani	Business	141 Street 6, Off: Khyab-e- Bukhari, Ph -VI, D.H.A, Karachi.	01 (One)	
Mr. Shehryar Faruque S/o. (Late) Mahmood Faruque CNIC # 42301-9099307-3	Pakistani	Business	13-A/II, 2 nd Sunset Street, D.H.A, Karachi.	01 (One)	
Mr. Tariq Faruque S/o. (Late) Iqbal Faruque CNIC # 42301-1565004-1	Pakistani	Business	13-A/I, 2 nd Sunset Street, D.H.A, Karachi.	01 (One)	
Mr. Abid Akber Vazir S/o. Akbar D. Vazir CNIC # 42301-3233346-1	Pakistani	Business	121/1, 6th Street Khyab-e- Rahat, Ph -VI, D.H.A, Karachi.	01 (One)	
Mr. Yasir Masood S/o. Masood Ahmed CNIC # 42301-6096167-7	Pakistani	Business	88/1, Street 25, Khyab -e- Saher, Ph- VI, D.H.A, Karachi	01 (One)	
Mr. Wasif Khalid S/o. Khalid Wahab CNIC # 42101-1893587-9	Pakistani	Business	D-30, Block "N" North Nazimabad, Karachi.	01 (One)	
				100 (Hundred)	

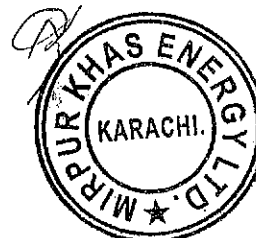
Dated this 18th day of July 2016

WITNESS TO ABOVE SIGNATURES:

Full Name: NIFT Pvt. Ltd. Signature: _____
Full Address: 5th Floor, AWT Plaza, I.I. Chundrigar Road, Karachi, 74200

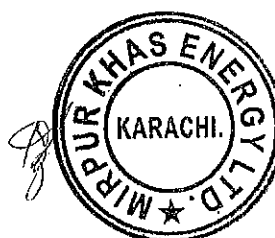
Details and Information pertaining to Form A
(This Form A will be due to submit with SECP on December 2017)

1	Registration No.	CUIN 0101020
2	Name of the Company	MIRPURKHAS ENERGY LIMITED
3	Registered office address:	Sub Post Office Sugar Mills Jamrao, Umerkot Road, Mirpurkhas.
4	Email Address:	abid.vazir@gfg.com.pk
5	Office Tel. No.:	021-35683566 - 021-35689538
6	Office Fax No.:	021-35683425
7	Nature of Business:	Power Generation, Supply and other allied related works.
8	Authorized Share Capital	
	Type of Shares	No. of Shares Amount Face Value
	Ordinary Shares	10,000,000 100,000,000 Rs. 10/= each
9	Paid up Share Capital	
	Type of Shares	No. of Shares Amount Issue Price
	Ordinary Shares	100,000 1,000,000 Rs. 10/= each
10	Amount of indebtedness on the date up to which form A is made in respect of all Mortgages/Charges	
11	Particulars of the holding company	
	Name	Mirpurkhas Sugar Mills Limited
	Registration No.	0001893
12	Chief Executive	
	Name	Mr. Aslam Faruque
	Address	141, street # 6, Khayaban-e-Bukhari Phase-VI, DHA, Karachi
13	Chief Accountant	
	Name	Mr. Wasif Khalid
	Address	D-30, Block "N" North Nazimabad, Karachi.
14	Secretary	
	Name	Mr. Abid A. Vazir
	Address	121/L, 6 th Street, Kh-e-Rahat, Phase-VI, DHA, Karachi.
15	Legal Adviser	
	Name	Mr. Irfan Ali Mangi - (KMS LAW ASSOCIATES)
	Address	207, Beaumont Plaza, Behind PIDC House, Karachi
16	Auditors	
	Name	Kreston Hyder Bhimiji & Co. Chartered Accountants,
	Address	16th Floor, Kashif Center, Shahrah-e-Faisal, Karachi



17	List of Directors		
Name of Director	Address	Nationality	CNIC
Mr. Aslam Faruque	141, Street # 6, Off: kh-e- Bukhari Ph-VI,DHA, Karachi	Pakistani	42301-6351391-7
Mr. Shehryar Faruque	13-A/II, 2nd Sunset St. DHA, Karachi.	Pakistani	42301-9099307-3
Mr. Tariq Faruque	13-A/I, 2nd Sunset St. DHA, Karachi.	Pakistani	42301-1565004-1
Mr. Abid A. Vazir	121/1, 6th Street, Khayaban-e-Rahat, Ph-VI, DHA, Karachi	Pakistani	42301-3233346-1
Mr. Yasir Masood	88/1, Street 25, Khayaban-e-Saher, Ph-VI, DHA, Karachi	Pakistani	42301-6096167-7
Mr. Wasif khalid	D-30, block "N" North Nazimabad, Karachi	Pakistani	42101-1893587-9

18.	List of Shareholders				
Folio	Name	Address	Nationality	No. of shares	CNIC
	Members				
	Mirpurkhas Sugar Mills Limited (Holding Company)	2nd Floor, Modern Motors House, Beaumont Road, Karachi	Pakistani	99,994	0001893
	Mr. Aslam Faruque	141, Street # 6, Off: kh-e- Bukhari Ph-VI,DHA, Karachi	Pakistani	01	42301-6351391-7
	Mr. Shehryar Faruque	13-A/II, 2nd Sunset Street DHA, Karachi.	Pakistani	01	42301-9099307-3
	Mr. Tariq Faruque	13-A/I, 2nd Sunset Street, DHA, Karachi	Pakistani	01	42301-1565004-1
	Mr. Abid A. Vazir	121/1, 6th Street, Khayaban-e-Rahat, Ph-VI, DHA, Karachi	Pakistani	01	42301-3233346-1
	Mr. Yasir Masood	88/1, Street 25, Khayaban-e-Saher, Ph-VI, DHA, Karachi	Pakistani	01	42301-6096167-7
	Mr. Wasif khalid	D-30, BLOCK "N" NORTH NAZIMABAD, KARACHI	Pakistani	01	42101-1893587-9
		Total:		100,000	



Sponsor Profile

Mirpurkhas Sugar Mills Limited, the main sponsor of the Mirpurkhas Energy Limited, is part of the Ghulam Faruque Group ("GFG") which ranks among the most prominent commercial & industrial business houses in Pakistan. Since its inception in 1964, the group has continuously strengthened and diversified its lines of operations. Ghulam Faruque Group consists of the following companies:

- Unienergy Limited
- Madian Power Private Limited
- Cherat Cement Company Limited
- Cherat Packaging Limited
- Unicol Limited
- Zensoft Private Limited
- Greaves Pakistan Private Limited
- Greaves Airconditioning Private Limited
- Greaves Engineering Services Private Limited
- Greaves CNG Private Limited

Experience of the Sponsor in Power Sector

The Sponsors possess over 25 years of experience in running and maintaining power plants in their respective manufacturing units. MSML has also acquired Generation License based on low pressure system from National Electric Power Regulatory Authority ("NEPRA") for supply of 8.5 MW to Hyderabad Electric Supply Company ("HESCO").

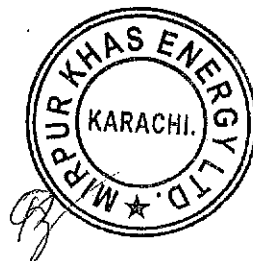
The combined installed capacity of the GFG owned power plants is over 40 MW. The management team has sufficient experience in executing cogeneration power projects and carrying out the operations and maintenance of power plants.

Moreover, the GFG companies have recently entered into a JV Project for a 50 MW Wind Power in Jhimpir, Sindh by the name of UniEnergy Ltd. The LOI and land has been secured for the project.

Furthermore, the group is part of another JV Project by the name of Madian Hydropower Limited established to setup a 148 MW hydropower plant.

Mirpurkhas Sugar Mills Limited ("MSML")

MSML was established in 1964 and the plant is located about 300 km from the port city of Karachi, in Mirpurkhas, Sindh. Its principal activity is manufacturing and selling of sugar. It is one of the most efficient sugar mills in Pakistan. The plant's current crushing capacity is 8,500 tons per day. Moreover, the company is involved in the development of high yield sugar cane varieties on its 1,700 acre experimental farms and in adjoining areas of mill.



MSML is listed on the Pakistan Stock Exchange and had an annual turnover of over PKR 3.8 billion and assets of over PKR 5.3 billion in 2016.

Board of Directors – Mirpurkhas Energy Limited (“MEL”)

The board members of Mirpurkhas Energy Limited include the following:

Mr. Aslam Faruque – Chief Executive

Mr. Aslam Faruque is a graduate from the University of Pacific, Stockton, USA, with a major in Marketing. He is the Chief Executive of Mirpurkhas Sugar Mills Ltd. Unicol Ltd and UniEnergy Ltd. He is on the Board of Directors of Greaves Airconditioning (Pvt.) Ltd, Greaves Engineering Services (Pvt.) Ltd, Zensoft (Pvt.) Ltd and Mirpurkhas Energy Ltd. In the past, he has served as the Chairman of Pakistan Sugar Mills Association– Sindh Zone, and Director of Sui Southern Gas Company Ltd, State Life Insurance Corporation of Pakistan and Pakistan Industrial Development Corporation.

Mr. Tariq Faruque – Director

Mr. Tariq Faruque graduated from Case Western Reserve University, USA. He holds a dual major in Economics and Political Science. He is a Director of Mirpurkhas Sugar Mills Ltd, Faruque (Pvt.) Ltd, Greaves Air-conditioning (Pvt.) Ltd, Greaves Engineering Services (Pvt.) Ltd, Zensoft (Pvt.) Ltd, Madian Hydro Power Ltd, Unicol Ltd and Mirpurkhas Energy Ltd.

Mr. Tariq Faruque was also a Member of the Board of Directors of Oil and Gas Development Company as well as served on the Board of Governors of Marie Adelaide Leprosy Centre. He is a 'Certified Director' from the Pakistan Institute of Corporate Governance.

Mr. Shehryar Faruque – Director

Mr. Shehryar Faruque is a graduate from Davis & Elkins College, Elkins, WV, USA. He serves on the Board of Directors of Cherat Cement Company Ltd, Mirpurkhas Sugar Mills Ltd, Faruque (Pvt.) Ltd, Greaves CNG (Pvt.) Ltd, Zensoft (Pvt.) Ltd and Mirpurkhas Energy Ltd. Mr. Shehryar Faruque is also serving as Director of NBP Fullerton Asset Management Company (NAFA) and Summit Bank Ltd.

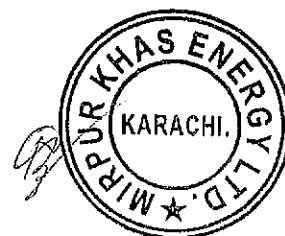
Mr. Abid A. Vazir – Director

Mr. Abid A. Vazir has been associated with Ghulam Faruque Group since 2000. In addition to other responsibilities he is also serving as the Executive Director of the group. He is also the Chief Executive of Greaves Air-conditioning (Pvt.) Ltd. and Greaves Engineering Services (Pvt.) Ltd. He is also a Director of Greaves CNG (Pvt.) Ltd. and Mirpurkhas Energy Ltd. Prior to joining Ghulam Faruque Group; Mr. Vazir was associated with New Jubilee Insurance Co. Ltd.

Mr. Abid Vazir holds an MBA degree from Lahore University of Management Sciences, enrolled in the Dean's Honors List. He is also an Associate member of the Institute of Chartered Secretaries of Pakistan. Mr. Vazir is a Certified Director from Pakistan Institute of Corporate Governance.

Mr. Yasir Masood – Director

Mr. Yasir Masood is a fellow member of Institute of Chartered Accountant of Pakistan. He is a Certified Internal Auditor (CIA) and qualified Certified Information System Auditor



(CISA). He is also a certified Director from Pakistan Institute of Code of Corporate Governance. He is a director in NBP Exchange Company Ltd. He is also serving on the board of Director of Mirpurkhas Sugar Mills Ltd, Greaves Air-conditioning (Pvt.) Ltd., Greaves CNG (Pvt.) Ltd, Greaves Engineering Services (Pvt.) Ltd and Mirpurkhas Energy Ltd.

He is the Executive Director and Chief Financial Officer of Cherat Cement Company Ltd, Cherat Packaging Ltd, Madian Hydro Power Ltd and Faruque (Pvt.) Ltd. He has been working and contributing in various committees of different Business forum.

Mr. Wasif Khalid – Director

Mr. Wasif Khalid is a fellow member of Institute of Chartered Accountant of Pakistan and Associate member of Pakistan Institute of Public Finance Accountants (PIPFA). He has also done his master in Business Administration (Marketing and Operations Management) from Hamdard University, Karachi.

He is the Executive Director Finance of Unicol Limited and Executive Director and Chief Financial Officer of Mirpurkhas Sugar Mills Ltd. and Zensoft (Pvt.) Ltd. Mr. Khalid is also serving on the board of Director of Greaves Air-conditioning (Pvt.) Ltd., Greaves CNG (Pvt.) Ltd Greaves Engineering Services (Pvt.) Ltd and Mirpurkhas Energy Ltd.

He has contributed immensely towards development of financial models and implementation of new projects. He has been actively involved with the regulators, practitioner and leading Shariah scholars of the industry for developing the commercial industry transaction and has successfully implemented Shariah on one of the Ghulam Faruque group companies thus making it Pakistan's first Shariah compliant company in Pakistan.

Prior to Ghulam Faruque group, Mr. Khalid was associated with various companies in Middle East and in Pakistan worked with one Big 4 audit firms. He has over 15 years' worth of rich experience in financial restructuring and modeling, project financings, operational management and internal audit.

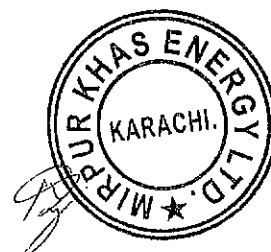
He is also serving as a Chairman of cost and budget committee, PSMA- Sindh Zone and Member committee agriculture development and reforms at Ministry of Industries and Production and Kisan Board on behalf of PSMA- Sindh Zone.

Management Team

Mr. Syed Muhammad Ali Khan

Mr. Syed Muhammad Ali Khan graduated in Mechanical Engineering from N.E.D Engineering in 1974. Later, he completed his Masters of Engineering from University of Hawaii.

Mr. Ali possess more than forty years of experience in construction of plants, cement manufacturing and sugar manufacturing. Mr. Ali joined Cherat Cement as an Engineer and worked up the ladder to become General Manager of the Company. He has also, worked as a COO of Dewan Cement Limited & Resident Director for Mirpurkhas Sugar Mills.



He has vast experience of plant erections including Boilers and Steam Turbo generators at Mirpurkhas and other Sugar Plants of Pakistan.

Mr. Naveed Siddique

Mr. Naveed Siddique is the General Manager Energy Projects for MEL. He is a power sector professional and is in the field for almost 40 years. He has served in Karachi Electric Supply Corporation on operations side and new power generation with allied transmission & grid station projects.

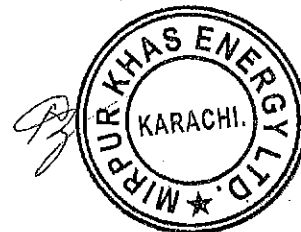
Mr. Naveed has also served in the Private Power and Infrastructure Board ("PPIB") and National Electric Power Regulatory Authority ("NEPRA"). Since last 15 years, he is in private power sector and has served on more than three (3) Independent Power Producers. He has also served on Energy Policy Program between the Government of Pakistan and USAID consultants.

Mr. Tahir Bashir

Mr. Tahir Bashir is M.Sc (Chem.) from the University of Agriculture Faisalabad and has also completed many professional trainings from Pakistan Institute of Management, Lahore University of Management (LUMs) and SGS Karachi.

Currently, Mr. Tahir is serving as General Manager, Operations & Project Head at Mirpurkhas Sugar Mills Ltd. He has vast experience of plant erections including Boilers and Steam Turbo generators at Mirpur Khas and other Sugar Plants of Pakistan.

Mr. Tahir has successfully completed many Projects of Energy savings at Mirpurkhas Sugar Mills with the coordination of international teams like IPRO Germany, Spray Engineering India, Escon Germany and HCTC China.



Technical Details and Design of the Facility

A- Plant Design

a. General

The design of the Facility is typical for a biomass-fired cogeneration facility which also is specific to the use of bagasse and to the cogeneration requirements.

The boilers will consist of tall water wall furnace with platen generators located at the top of the furnace. The super heater will have three stages. The first stage is a horizontal tube convective super heater located in the boiler second pass. The second stage consists of platens located at the top of the furnace adjacent to the generator section. The third stage consists of pendants located above the furnace arch between the second and first stages. Following the super heater will be three horizontal tube economizer sections and four tubular air heater sections.

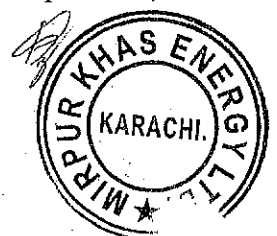
The steam cycle consists of two high pressure feed water heaters and a Deaerator for each unit. The high pressure feed water heaters take steam from the two uncontrolled extractions of the steam turbine. Steam for the Deaerator is to be supplied from the controlled extraction of the steam turbine.

The Facility has two modes of operation defined by steam needs of MSML. During the crushing season, MSML needs steam and electricity to crush the sugar cane and produce sugar. Steam for MSML will be supplied from the controlled extraction of the steam turbine which is at approximately 3 bar (a) pressure. The expected steam demand for MSML is 87.5 tons/hr from Cogeneration HP Power Plant. Total electricity demand of Sugar Plant is during the crushing season is 9.21 MW out of which 4.01 MW will be supplied from Cogeneration HP Power Plant. During the off-season, the electricity demand is 0.5 MW.

b. Technology

Combustion technology based on the Rankine Cycle will be utilized in this project which is proven latest technology. The bagasse will be combusted in a high pressure boiler and the steam generated will be fed to the steam turbine to generate power. The turbine will be different from the conventional thermal power plants as the turbine will be provided with a controlled extraction for extracting the process steam required for the sugar mill. To enhance the efficiency of operation, regenerative heaters are used in the feed water circuit. For the cogeneration power plant proposed for MEL, the cogeneration cycle is based on the parameters of 110 bar (a) and 540 degree centigrade at the boiler outlet, currently being used in many countries for the cogeneration projects. The cycle chosen with the above parameters is the latest used in many of the bagasse fired installations around the world. These above selected parameters make the cycle more efficient and help in the generation of more units for the same quantum of the fuel.

There are already many Cogeneration plants operating in Pakistan & India with these parameters and the operating experience of those plants, in synchronization with the sugar mill operation,



has been smooth and without any hitch. The Cogeneration scheme for MEL proposes 1x130 TPH capacity boilers and 1x26 MW extraction condensing turbo generators. Considering the offseason operation of the plant, the Cogeneration power plant boilers will be designed for firing the saved bagasse and a few other compatible bio-mass fuels.

B- Project Specifications and Equipment

a. Bagasse Fired Boiler

The Boiler shall be single drum, natural circulation, radiant furnace with water cooled membrane wall, three stage super-heater with two stage attemperator, balanced draft and travelling grate bagasse fired boiler. The boiler is capable of a peak generation of 110% of the MCR for a period of half an hour in eight hour shift. The boiler shall be top supported, outdoor type, with adequate provisions for the thermal expansion of the boilers in all directions.

Design Parameters:

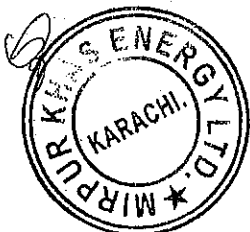
- Bagasse Fired Boiler; 130 TPH
- Steam pressure at the Main Steam stop valve outlet: 110 bar(a)
- Steam temperature at the Main steam stop valve outlet at MCR: 540 ± 5 °C
- Boiler feed water temperature at the inlet to the Deaerator: 95 °C.
- Maximum noise level at 1.0 m distance for the boiler: 85 dB(A)
- Maximum noise level at 1.0 m for boiler drum safety valves: 80 dB(A)

The Bagasse through drum feeders, screw feeders and pneumatic spreaders will be fed into the furnace. The travelling grate is selected for efficient combustion system and to avoid heating of grates. The Ash is collected by the continuous movement of travelling grate.

The air will be supplied by primary Forced Draft (FD) fans & secondary air fans. The air towards Bagasse and coal will be controlled by the fuel air control system in order to guarantee safe and optimum combustion. The air supplied from FD fan will be heated up in air pre-heater. The pressure in the furnace will be controlled by the Induced Draft (ID) fans installed at outlet of boiler. These fans will be provided with Variable Frequency Drive (VFD) in order to optimize the power consumption. ID fans will discharge flue gases.

After complete combustion in furnace the flue gases shall enter the super heater section installed in the upper portion of the furnace. From the super heaters the flue gases will flow downwards into modular bank. The evaporator section of the boiler will be designed for a large circulation ratio. Even during quick plant load changes the water circulation will be stable and thus prevent steam blockage in the evaporator sections.

From evaporator section, the flue gas shall enter the bare tube economizer from the top and leave at the bottom to Air Flue Gas Pre - heater. The economizer tubes will be supported in the structure of the economizer casing and will be bottom supported. The economizer will be fully drainable.



Thereafter, the Fly Ash Arrestor installed at the outlet of the Air Pre - heater. From Fly Ash Arrestor most of the fly ash will be separated from the flue gases.

The condensate from the sugar mill shall be directly fed into the condensate tank from where it will be pumped to the Deaerator via sugar plant exhaust condensate pumps through a level control system.

Demineralized (DM) water will be supplied to the boiler for makeup. The makeup water will be pumped to the overhead surge tank via DM water distribution pumps. The makeup water will be added in the condenser hot well from the overhead surge tank by gravity through a level control system. The condensate from the condenser and makeup water added to the condenser hot well will be pumped to the Deaerator by condensate extraction pumps.

3x50% Boiler Feed Water (BFW) pumps shall be provided. BFW pumps are multistage, centrifugal type with low voltage 415V drive motors with Variable Frequency Drives (VFDs). The condensate and make-up water lines will have level control valve to control deaerator level.

The control philosophy, boilers interlock and protection logic shall be implemented in Distributed Control System (DCS) for safe operation of boiler.

b. Steam Turbine and Auxiliaries

i. Steam Turbine

The turbine of the cogeneration power plant will be multistage nozzle governed, horizontal spindle, two bearings, and extraction cum condensing type with 03 number of uncontrolled extractions and 01 number of control extractions. The exhaust from the turbine will be condensed in the surface condenser at 0.101 bar (a) pressure during off-season operation.

The low pressure steam at 3 bar (a), 133.6⁰C will be supplied to the sugar plant for juice heating in the evaporator station. The medium pressure steam at 6 bar (a), 350⁰C will be supplied for centrifugal washing. 87.5% condensate of the supplied LP steam will be returned from the sugar mill. There will be no condensate return of medium pressures steam.

ii. Gear Box

Heavy duty reduction gear box of Double helical type with hardened & ground gears will be installed, capable of transmitting maximum power generated by turbine and able to withstand 20% over speed over a period of minimum 5 minutes.

The gear box will be designed with a service factor of 1.3 as per AGMA requirements.

iii. Couplings

High speed coupling between the turbine & the gear box will be non-lubricating, steel laminated, flexible type. The coupling between the gear box and the alternator will be low speed. Both the couplings will have coupling guards and acoustic covers. Power rating of the couplings shall be in accordance with AGMA 514



iv. Condensing System

Condensing system shall comprise of the following:

- Shell & Tube horizontal type surface condenser with integral hot well, thermal relief valve and atmospheric relief valve.
- Steam Ejector system consisting of:
 - Twin stage main ejectors (1 working + 1 standby) with two surface type inter and after condensers.
 - Startup hogging type ejector with silencer.
- Vertical canister type Condensate extraction pumps (CEP's), with a 3 x 50% capacity with LT motors and suction valves.
- Rupture disc for condenser protection.
- Expansion bellow with spool piece between turbine exhaust and condenser inlet
- Dry air/vapor line within specified battery limit

c. AC Generator

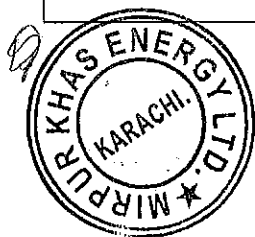
AC Generator shall comprise of the following:

- Brush-less exciter with PMG
- Air coolers
- Twin bearings
- AVR cum Excitation panel
- Anti-condensation heaters
- Water leakage detector- 1 per cooler
- Lube oil flow regulator - 1 per bearing

Generator shall be supplied in line with the following specifications:

Table 1: Generator Specifications

Description	Parameters
Rating & Count	26 MW
Type	Synchronous type
Number of pole & Excitation System	Four pole, with brushless excitation system.
Power Factor	0.8PF (lagging) to 0.95(leading) under entire band of +10% voltage variation and +5% frequency variation
Insulation Class	Class 'F' insulation and shall be suitable for operation within class 'B' limits
Overload Requirements	Over loading of 110% for one hour every 12 hours and 150% for 30 seconds



Short Circuit and Overload Endurance	Generator shall withstand short-circuit of any kind at its terminal, while operating at rated load and 105% rated voltage for at least 3 seconds .
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i. Generator Protection and Control System:

Generation protection and control system will consist of the following equipment:

- Generator protection (Relay) Panel
- Metering & Synchronizing Panel
- MCC Panel
- Lightning arrestor, Surge capacitor and Potential transformer (LA, SC & PT) Panel
- Neutral grounding resistor (NGR) Panel
- DC Distribution

d. Governing System

The governor system provided will control the acceleration of the turbo generator and prevent over speed without tripping the unit under any operating condition or in the event of maximum load rejection.

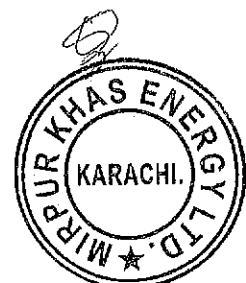
The governor system will have the following important functions:

- Speed control
- Over speed control
- Load control
- Inlet steam pressure control
- Extraction pressure control

e. Lubrication and Control System

A single forced feed lubrication system will be installed for Turbine, Gearbox & Alternator comprising of the following major components:

- Lube oil tank
- Oil Vapor extractor
- AC Electric Main Oil Pump (MOP) driven by gearbox low speed shaft
- AC electric Motor driven Auxiliary Oil Pump (AOP)
- DC Motor driven Emergency lube Oil Pump (EOP) with auto cut-in & cut-out facility
- Lube oil coolers (1 working + 1 standby)
- Lube oil filters (1 working + 1 standby)
- AC motor driven oil mist separator mounted on oil tank



f. Control Oil System

Control oil system will comprise of the following:

- AC electric Motor driven Auxiliary Control Oil Pump (ACOP) (1 working + 1 standby) to supply oil to Control system.
- Control Oil filter (COF) (1 working + 1 standby)

g. Main Cooling Water Pumps

The cooling water system shall be designed to provide cooling water to the following area of the plant:

- Surface Condenser
- Auxiliary cooling water coolers

The cooling water system includes the following major components:

i. Main Cooling Water Pumps

Three (3) Main Cooling Water Pumps (two working and one standby) each of capacity approximately 2800 m³/hr shall be provided. Pumps will be horizontal centrifugal type, driven by electric motors.

ii. Auxiliary Cooling Water Pumps

Two (2) Auxiliary Cooling Water Pump (One working and one standby) will be provided. Pumps will be horizontal centrifugal type driven by electric motors.

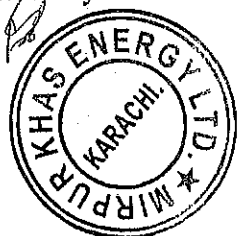
iii. Cooling Tower System

The Cooling Tower System shall have the following specifications:

- One (1) R.C.C structure mechanically induced draft, counter flow type cooling tower
- Capacity of cooling tower will be approximately 5600 m³/hr and is combined and common for the whole cogeneration power plant.
- There shall be 2 cells each having a capacity of approximately 2800 m³/hr.
- The cooling tower will be designed for cooling of water from 42°C to 34°C, and an approach of 5-6°C while operating under the atmospheric wet bulb temperature of about 30°C.
- Each cell of cooling tower gear box will be equipped with vibration switches, oil temperature and oil level controls.
- The source of cooling water will be Bore Well Water.
- Cooling water supply and return temperature is 34°C and 42°C respectively.

h. Raw Water System

Raw water system consists off the following components:



i. Cooling Water Makeup Pump

Two (2) Cooling Tower make up Water Pumps for season and off-season operation will be provided.

ii. Raw Water Transfer Pumps

Two (2) Raw Water Transfer Pumps (one working and one standby) each of capacity 20 m³/hr will be provided to ensure raw water supply to Water Treatment Plant.

i. Compressed Air System

The function of this system is to provide service and instrument air for cogeneration plant operations. Compressed air system provides air to following users:

- **Instrument Air Users:** Instrument air will be required for the operation of pneumatic instruments like I/P converters, purge instruments, pneumatic actuation of control valves, dampers etc.
- **Service Air Users:** Service air will be required for cleaning of filters, strainers and general purpose.

j. Bagasse Handling System

The bagasse handling system comprising of chain conveyors & belt conveyors to transport the required quantity of bagasse from sugar mill to cogeneration shall be provided. Bagasse from the sugar mill shall be fed to the boiler from a front mounted chain conveyor. Excess bagasse shall be returned to the bagasse storage yard. During off-season/non availability of bagasse from mill, the cogeneration boiler shall use saved bagasse from the storage yard.

k. Ash Handling System

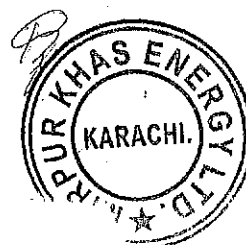
The ash handling system envisaged for the cogeneration boiler shall consist of Submerged Ash Belt Conveyor System and Dense Phase Ash Handling System.

C- Plant Operating Voltage

The plant shall be designed suitable for operating at a frequency of 50Hz, with voltage levels of various systems of the plant as given in Table 2 below:

Table 2: Plant Operating Voltage

Generation (TG) system	11 kV
Power evacuation system	132 kV
Non-AC VSD / auxiliaries of cogeneration plant	415 V
AC VSD / auxiliaries of co-generation plant	415 V
DC system of co-generation plant	110 V
UPS system of co-generation plant	220 V



a. Basic Electrical Design Parameters

Basic electrical design parameters for the Plant are given in the table below:

Table 3: Basic Electrical Design Parameters

Power Factor (lagging)	.8
Generation Voltage (kV)	11 kV, 3 phase
Parallel operation with Grid	Required with 132kV grid
Grid Voltage	132 kV, 3 phase
System Frequency	50 \pm 5%
System Voltage Variation	\pm 10% Variation of Rated Voltage

D- 132kV Switchyard

Switchyard shall be supplied for interface with NTDC Grid in line with following specifications and NTDC requirements. Detailed specifications of the switchyard are given in the table below:

Table 4: 132kV Switchyard Specifications

Voltage Level	132kV
Service	Outdoor AIS with SF6 circuit breakers
Number of Bays	2 OHL Bays 2 Transformer Bays 1 Bus-Coupler Bay
Bus Bar	AAC conductor of "Hawthorn"
Short Circuit SF6, gang operated	3150Amp 40kA 1sec
Isolator (Centre break, motor operated with copper alloy blades)	3150 Amp
Protection & Metering	As per NTDC Requirements
Highest System Voltage(kV rms)	145 kV
Power frequency withstand capability (kV rms)	275kV
Basic insulation level (kV peak)	650 kV
Creepage distance for insulators (mm/kV)	25mm
Instrument Transformers	Hermetically sealed, dead tank design. Rating as per SLD
Insulator	Brown glazed with min 6kN cantilever Strength
Towers & Support Structures	MS galvanized lattice type
Tariff Metering equipment	Three elements four-wire configuration, electronic, digital, with accuracy class of 0.2S; 30 minutes intervals for a period of 70 days with



	intervals programmable from 5 minutes to 30 minutes
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a. Isolated Phase Bus Duct

Generator shall be connected to 11kV panel through Isolated Phase Bus Duct with Aluminum conductors. All other electrical distribution connections shall be through MV or LV rated cables as per application and voltage grade. Technical details of the Isolated Phase Bus Duct are given in the table below:

Table 5: Insolated Phase Bus Duct Specifications

Application	Steam Generator Connection to 11kV Panel
Power Frequency Withstand Voltage	28kV
BIL	75kVp
Enclosure	Minimum thick of 3mm
Sizing Basis	Maximum through fault current either from 132kV grid or from the generator including contribution from total plant loads through Auxiliary Transformers with 20% margin on higher side or 50kA, whichever is higher

b. 11kV Switchboard

Switchboard rated 11kV IP4X 3150Amp 40kA for 3 sec shall be provided for feeding transformers and connection to steam generator.

c. 400 V Switchboard

All the cogeneration plant auxiliary loads shall be segregated into two groups, each consisting of AC Variable Speed Drive (AC VSD) driven loads and non-AC VSD driven loads.

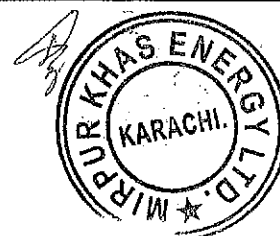
All AC VSD loads and non-AC VSD loads pertaining to cogeneration plant shall be connected to two (2) AC VSD transformers. Common systems like cooling water [main & auxiliary cooling water pumps and cooling tower fans] shall be distributed uniformly on both VSD transformers.

d. Transformers

Technical specifications of the different transformers to be installed in the Project are given in the table below:

Table 6: Specifications of Transformers

Description	Parameters
Generator transformer (GT) / Power Transformer	28/35MVA, 11kV/132kv, YNd1
VSD transformers [Three winding transformer] for co-generation plant	2x4 MVA 11kv/0.415/0.415 kV, Dzn0yn11 Dyn11



Lighting Transformer	Cast Resin Encapsulated 200kVA, 0.4kV/0.4kV, 50Hz, Dyn11, ONAN, Three Phase, Two Windings
Neutral Grounding Transformer	Yd windings, 50A for 10Sec & 500A for 3Sec, 11KV, ONAN

e. AC & DC UPS System

AC and DC UPS system will be supplied for loads that require un-interrupted power. Following UPS shall be supplied for this purpose:

Table 7: AC & DC UPS Specifications

Description	Parameters
110VDC	2x100% Dual Redundant UPS with Dedicated Battery Bank [SMF type: Sealed Maintenance Free]
230VAC UPS	2x100% Dual Redundant UPS with Dedicated Battery Bank [SMF type: Sealed Maintenance Free]
Lighting 230VAC UPS	1x100% UPS with single battery bank [SMF type: Sealed Maintenance Free]

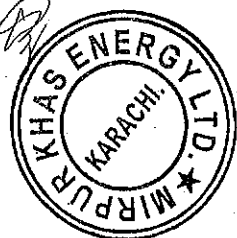
f. Control Philosophy & Interfacing

Critical and important electrical loads shall be interfaced with SCADA system [built in plant DCS] for local and remote operation in-line with plant operational & safety requirements.

g. Energy Management System

The incoming and outgoing feeders of 132kV Switchyard Bays, Main MV [PCC] Panel and AC-VSD panel outgoing feeders shall be provided with PQM/TVM with communication port suitable for MODBUS-RTU protocol. One daisy chained link shall be provided for each switchboard which will communicate soft data to Plant DCS. All these meters shall be hooked up to a dedicated Energy Management System for data logging built in plant DCS.

Communication ports of MODBUS - RTU shall be planned in all TVMs and PQMs provided in the PCCs, AC VSD panels and control panels of the TG, Generator Transformer and switchyard control and relay panels. All the ports shall be hooked up to Energy Management System (Part of DCS) for data logging as well as monitoring purposes. The mimic representation of the complete electrical distribution shall be provided in Energy Management System (part of DCS) from 132 kV level to major/main LT panels.



h. RTDs & Thermistors

Thermistors shall be installed on motors rated between 7.5 to 300 kW. RTD shall be made available for motors more than 300kW. All RTDs shall be hooked up with relays in Motor Relays in respective MCC.

i. System Earthing

The grounding installation work shall be as per recommendation of IEEE-80. All panels, transformer, LAVT, NGR and motors shall be provided with double earthing. Lightning protection for tall structure shall be in line with IEC standards.

132kV system shall be solidly grounded through 132 kV side of transformer neutrals at NTDC side as well as neutral of generator transformer on 132 kV side at co-generation plant.

TG system shall be grounded through Neutral Grounding Resistor (NGR) panel to limit the earth fault current to 50A to suit the system requirement, through the 11 kV neutral point of TG. The 11kV system shall be provided with 11 kV Earthing Transformer and Neutral Grounding Resistor (NGR) panel to limit the earth fault current to 50A. This NGR of earthing transformer shall be switched ON whenever the power is imported from the grid with TG circuit breaker in open condition. The 11kV system at the secondary side of Interconnection Transformer shall be provided with NGR grounding to limit earth fault current of 50 A.

LV system 400V system shall be solidly grounded through transformer neutral. Neutral bus bars shall be made available in 400V PCCs, and all MCCs.

415V VSD transformer grounding system shall be as for 12 Pulse AC VSD drives – Solidly grounded.

415V system used for illumination system and small power distribution system shall be solidly grounded.

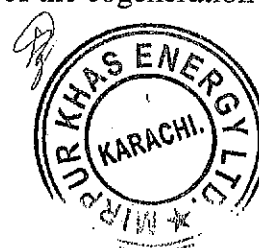
E- Water Treatment System

The Cogeneration power plant make up water requirements will be met from the bore wells located in the sugar plant. For the make up for the cycle, it is proposed to take the raw water through a Water Treatment Plant with the following treatment scheme.

→ 2 x Two Stage Reverse Osmosis system → 2 x Electro De Ionization system. (2x MGF + 2xRO 2 x Multi-grade Filter + 2x EDI) There shall be two independent streams. The capacity of water treatment plant is 70 m³/hr. DM water is collected in two DM water tanks each having a capacity of 700 m³. Water will be distributed from DM tanks through pumps to different users i.e. Deaerator, Condenser etc.

F- Firefighting System

The function of fire-fighting system is to supply water to the main risk areas of the cogeneration



power plant.

The fire protection system is required for early detection, containment and suppression of fires. A comprehensive fire protection system shall be provided to meet the above objective and all statutory and insurance requirements of National Fire Protection Association (NFPA).

The fire-fighting system shall consist of the following:

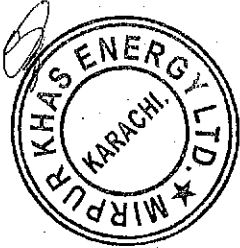
i. Stand Pipe and Hose System:

Stand pipe and hose system shall be provided to cover the building and structures of the cogeneration plant. The system shall be designed as per the NFPA 14.

Standpipe shall have a hose of 65mm diameter with connection to a large supply of water. The hose connection shall be not less than 0.9m or more than 1.5m above the floor.

ii. Fire Hydrant and Water Monitoring System

The hydrant system shall be provided to cover all areas. The system shall be designed as per NFPA 24. The system shall consist of over ground hydrant mains laid in rings, isolation valves, and stand pipes with hydrant valves (outdoor). A Hydrant shall be placed after every 40m.



Mirpurkhas Energy Limited

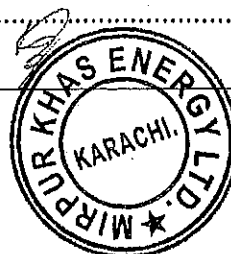
26 MW Bagasse-based Cogeneration Power Project
Jamrao, Mirpurkhas, Sindh

Feasibility Report



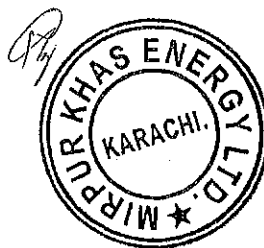
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1 Project Background

Mirpurkhas Sugar Mills Limited (“MSML”) through a wholly-owned subsidiary Mirpurkhas Energy Limited (“MEL”) intends to set up a green field 26 MW (Gross) high-pressure bagasse based co-generation power plant (“Project”) under the provisions of the Framework for Power Cogeneration 2013 (“Framework”) and Policy for Development of Renewable Energy for Power Generation 2006 (“RE Policy” or “Policy”). The Project will be located adjacent to MSML located at Jamrao, Umerkot Road, Mirpurkhas, Sindh, Pakistan.

The Project will sell power to the national grid through sale of energy to the Central Power Purchasing Agency Guarantee Limited (“CPPA-G”) under a 30-year Energy Purchase Agreement (“EPA”) as well partially meet the steam and power requirements of MSML during the crushing season. The Project will enable MSML to establish a sustainable market for its by-product, bagasse, and will also allow the sponsors of MSML to take an exposure in the power sector through incentives offered by the Government of Pakistan (“GoP”) under the Framework and RE Policy.

The objective of this feasibility report (“Feasibility”) is to assist MSML in assessing the viability of the Project under a *given set of assumptions*.

2 Power Market

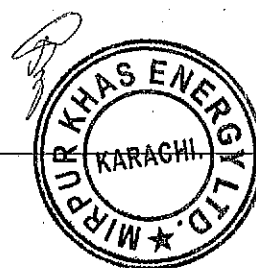
2.1 Structure of Power Sector in Pakistan

Historically, the power sector in Pakistan has been owned and operated by government entities, primarily the Water and Power Development Authority (“WAPDA”) until the drive to unbundle started in the early 1990s. Since then the sector has evolved much with private sector involvement primarily in generation and more recently on the model of a fully vertically integrated utility company. The generation, transmission, distribution and retail supply of electricity in Pakistan is presently undertaken by a number of public and private sector entities comprising of one (1) national transmission company; nine (9) regional public sector-owned distribution companies; four (4) public sector thermal generation companies; one (1) public sector hydropower generation company and several Independent Power Producers (“IPPs”). These entities enable the supply of power to the entire country except for Karachi. The metropolitan city of Karachi and some of its surrounding areas are supplied power K-Electric, which is a vertically integrated utility owned by the private sector responsible for the generation, transmission and distribution of electricity in its region. The total installed capacity of the entire country in 2015 was 24,823 MW of which 16,814 MW (67.74%) was thermal, 7,116 (28.67%) was hydroelectric, 787 MW (3.17%) was nuclear and 106 MW (0.43%) was wind.

Table 1: Pakistan Power Generation Capacity

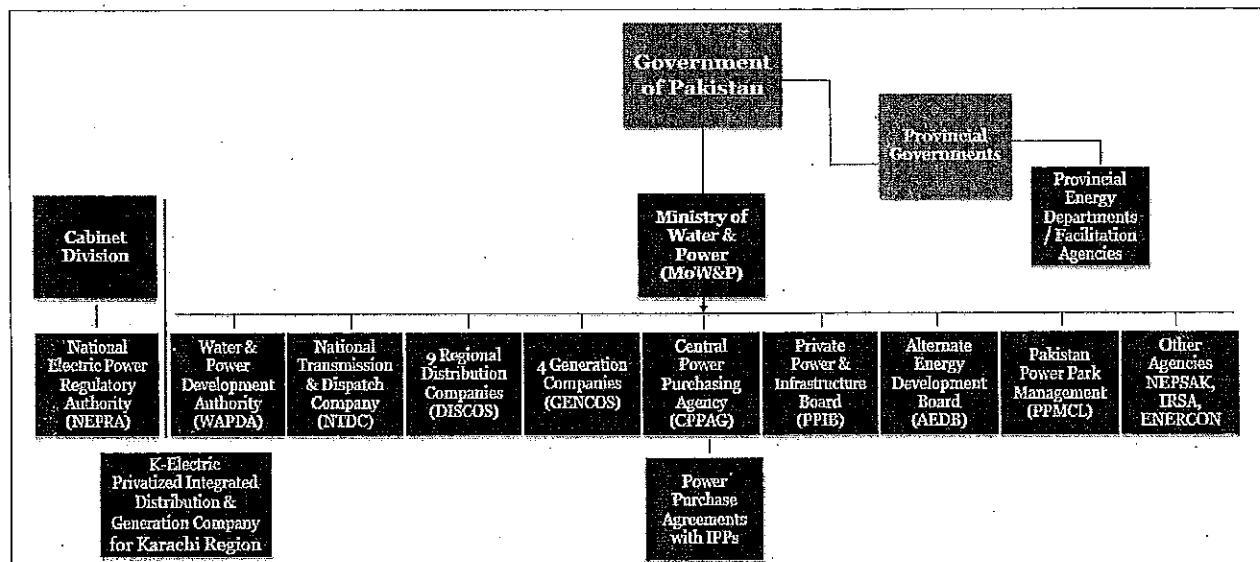
As on 30 th June	2011	2012	2013	2014	2015
Thermal	15,910	15,969	15,941	15,719	16,814
Hydropower	6,645	6,730	6,947	7,116	7,116
Nuclear	787	787	787	787	787
Wind	0	1	50	106	106
Total	23,342	23,487	23,725	23,728	24,823

All figures in MW; Source: NEPRA State of Industry Report, 2015



More recently the CPPA, previously residing within NTDC, has been converted into a legal, independent body acting as a central counterparty to power purchase transactions. The present form of the power structure in Pakistan is presented below:

Table 1: Pakistan Power Sector Structure



2.2 Electricity Generation

Historically, Pakistan has relied on hydropower generation to meet its electricity demands, as the ratio of hydel to thermal installed generation capacity in the country in 1985 was about 67% to 33%. However, with the passage of time, the energy mix has shifted towards thermal power generation, which now generates approximately 65% of total power produced in the country. Electrical energy generated in recent years by fuel type is presented in the table below:

Table 2: Pakistan Energy Generation by Source

As on 30 th June	2010-11	2011-12	2012-13	2013-14	2013-14
Thermal	65,169	64,478	64,034	68,082	69,988
% Share	64.79	65.94	64.91	64.41	64.17
Hydel	31,990	28,643	30,033	32,239	32,979
% Share	31.80	28.85	30.44	30.50	30.24
Nuclear	3,130	4,872	4,181	4,695	5,349
% Share	3.11	4.91	4.24	4.44	4.90
Import	295	296	375	419	443
% Share	0.29	0.30	0.38	0.40	0.41
Wind	0	6	32	263	300
% Share	0.00	0.01	0.03	0.25	0.27
Total	100,584	99,295	98,655	105,698	109,059

All figures in GWh; Source: NEPRA State of Industry Report, 2015

Given the acute gas shortage in the country, thermal generation has relied mostly on expensive fuels such as Furnace Oil and High Speed Diesel. Increased dependence on expensive thermal fuel sources has not only led to high cost of generation but has also resulted in large amounts of

foreign reserves to be spent on the import of fuel. Thermal generation breakdown in the country in recent years is given in the table below:

Table 3: Pakistan Energy Generation by Source (Thermal Fuel Mix)

	2010-11	2011-12	2012-13	2013-14	2014-15
Gas	37,076	30,162	28,190	30,769	31,196
% share of thermal generation	56.89	46.06	44.02	45.19	44.57
FO + HSD	27,984	35,250	35,804	37,201	38,690
% share of thermal generation	42.94	53.83	55.91	54.64	55.28
Coal	109	66	40	112	102
% share of thermal generation	0.17	0.10	0.06	0.16	0.15
Total	65,169	65,478	64,034	68,082	69,988

All figures in GWh; Source: PSS/NTDC/KEL

Due to this skewed energy mix, it has now become imperative upon the power sector in Pakistan to move towards generation technologies that are sustainable and rely on indigenous resources.

2.3 Demand and Supply of Electricity

For the past decade or so, Pakistan has been suffering from an acute energy crisis due to rising demand exacerbated by structural flaws within the sector. Some of the major reasons contributing to this crisis include:

1. Inefficient transmission and distribution
2. Increasing demand
3. Inefficient use of energy
4. Expensive energy mix and
5. Improper pricing.

Installed capacity in the country grew at an average rate of 5.51% during the period 1990-2015. However, this increase in capacity has been unable to meet the demand of electricity leading to a demand-supply gap, which can go as high as 6,600 MW during peak hours. In 2015, the maximum generation capability remained at 19,132 MW, while the maximum peak demand reached 24,757 MW, resulting in a 5,625 MW gap between supply and demand. Projections by government agencies depict that this shortfall is not going to end till 2018. The tables below show the actual and projected surplus/deficit in demand during system peak hours:

Table 4: Pakistan Historical Supply and Demand of Power

Year	Generation Capacity	Peak Demand	Surplus/(Deficit)
2011	15,430	21,086	-5,656
2012	14,483	21,536	-7,053
2013	16,846	21,605	-4,759
2014	18,771	23,505	-4,734
2015	19,132	24,757	-5,625

All figures in MW; Source: NTDC

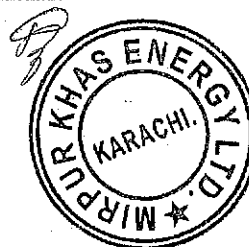


Table 5: Pakistan Projected Supply and Demand of Power

Year	Planned Generation	Projected Peak Demand	Surplus/(Deficit)
2016	20,303	25,666	-5,363
2017	23,445	27,185	-3,740
2018	28,751	28,678	73
2019	33,545	30,154	3,391
2020	35,590	31,625	3,965

Source: NTDC

Shortage of electricity has become the most critical challenge by not only causing social disruption, but also affecting the economic growth of the country. According to estimates, energy shortages in the country have resulted in approximately 2% reduction in the annual GDP of the country. Therefore, resolving the energy crisis is amongst the top priorities of the government and steps are being taken to attract new investment in the power sector. Moreover, steps are being taken to optimize the generation mix by adding renewable and indigenous energy sources.

2.4 Key Organizations

2.4.1 National Electric Power Regulatory Authority (“NEPRA”)

In order to promote fair competition in the industry and to protect the rights of consumers as well as producers/sellers of electricity, the GOP enacted the Regulation of Generation, Transmission and Distribution of Electric Power Regulation Act, 1997 (“NEPRA Act”). Under this Act, the NEPRA Policy for Power Generation Projects was established for regulating electric power generation, transmission and distribution in Pakistan. In performing its functions under this Act, NEPRA is required to, as far as reasonably possible, protect the interests of consumers and companies providing electric power services in accordance with the guidelines laid down by the government. One of NEPRA’s most prominent roles is tariff approval for the Project.

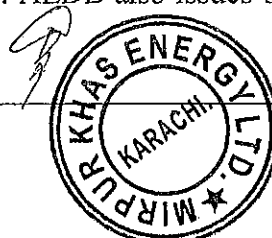
NEPRA’s role in the power business, inter alia, is to issue licenses for companies and to regulate their operations according to NEPRA rules and regulations. The prospective applicants will be required to comply with all NEPRA rules/procedures, inter alia, for grant of license before security agreements are concluded for any project.

2.4.2 Private Power and Infrastructure Board (“PPIB”)

PPIB provides a one-window facility to IPPs for implementation of projects above 50 MW capacity and issues the Letter of Interest (“LOI”) and Letter of Support (“LOS”), prepares pre-qualification and bid documents, pre-qualifies the sponsors, evaluates the bids of pre-qualified sponsors, assists the sponsors/project companies in seeking necessary consents / permissions from various governmental agencies, carries out negotiations on the Implementation Agreement (“IA”), assists the power purchaser, fuel supplier, government authorities in the negotiations, execution and administration of the EPA, fuel supply agreement and water use license respectively, issues and administers the GOP guarantee backing up the power purchaser, fuel supplier and follows up on implementation and monitoring of projects.

2.4.3 Alternate Energy Development Board (“AEDB”)

AEDB has been designated as one-window facility for processing all alternative and renewable energy projects in the private sector projects such as wind, biodiesel, bagasse/biomass/waste to energy, small/mini/micro hydro and solar power projects. AEDB also issues bankable IA, EPA,



LOI and LOS to alternative energy producers. AEDB shall be the relevant GoP facilitation agency for the issuance of the LOI and LOS as well negotiation of the IA and provision of the GoP guarantee as applicable for the Project.

2.4.4 Central Power Purchasing Authority Guarantee Limited ("CPPA-G")

CPPA-G, a company created by Government of Pakistan, is a non-profit independent company established under the Companies Ordinance, 1984 and solely responsible for implementing and administering the "Single Buyer Plus" market mechanism (ultimately leading to competitive market operations). CPPA-G purchases power on behalf of Distribution Companies ("DISCOS") from IPPs. The Project shall be entering into negotiations with CPPA-G for the sale of energy to the national grid and shall enter into an EPA in this regard.

2.4.5 Hyderabad Electric Supply Company ("HESCO")

HESCO was formed to take over/acquire all the properties, assets and liabilities of Hyderabad Area Electricity Board owned by WAPDA. The company was incorporated on 23rd April 1998 and certificate for commencement of business was obtained on 1st July 1998 from NEPRA. HESCO serves 975,346 consumers and has administratively divided 12 districts of Sindh Province into 4 operation Circles: Hyderabad, Laar, Nawabshah and Mirpurkhas.

3 Applicable Framework & Policy

The Project is being set up under the Framework for Power Cogeneration 2013 pursuant to the Policy for Development of Renewable Energy for Power Generation 2006 being administered by the AEDB. Under the terms of the Framework and Policy, electricity purchase by the CPPA-G from bagasse-based projects has been made mandatory.

The conditions of the Framework/Policy envisage MSML/MEL seeking an LOI from AEDB for the Project (which the company has already been issued). In May 2013, NEPRA announced an upfront tariff ("**Upfront Tariff**") for high-pressure boiler based bagasse projects being set up under the Framework. The Upfront Tariff has subsequently been extended up to May 2017; the Company shall upon completion of the applicable pre-requisites apply to NEPRA for the same.

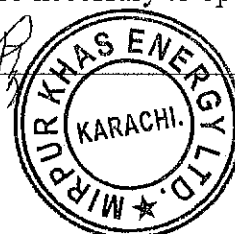
Upon receipt of the Upfront Tariff approval from NEPRA the Project Company shall seek an LOS from AEDB; following which the Company shall enter into negotiations of the EPA and IA with CPPA-G and AEDB respectively, which shall be followed by the financial close of the Project. Under the terms of the Upfront Tariff (and LOS) the Company is required to achieve the commercial operations date of the Project within 24 months from date of approval of the Upfront Tariff for the Company.

In parallel, the Company shall also apply to NEPRA for the issuance of the generation license for the Project. The application for the generation license shall be made following the issuance of the LOI and will be issued, amongst others, after submission of an approved grid interconnection study from HESCO and an environmental study from the relevant authority.

4 Cogeneration

4.1 Bagasse Based Cogeneration

Cogeneration refers to generation of electricity and useful heat from use of a single fuel at high efficiency. Cogeneration is a well-known process in sugar industry as every sugar mill requires steam for sugar manufacturing while supply of electricity is also necessary to operate machinery.



The steam provides thermal energy which is used in heating and concentrating the juice into syrup. This process of juice concentration to syrup involves the evaporation of water in the juice by using low pressure steam as the heating medium. With the large quantum of low pressure steam usage, the sugar industry stands as an ideal candidate for cogeneration. Historically, most sugar mill boilers and the power houses were designed primarily to meet the process steam and electricity requirements of the sugar mill. Therefore, the boilers and turbo-generators employed are mostly of low pressure and low temperature style.

There has been, of late, increasing awareness of the advantages of installation of high pressure, high efficiency bagasse based systems. With installation of high pressure boilers, electricity over and above internal use can also be produced and sold to national grid, if allowed. Exports of electricity can make cogeneration an attractive and cost-efficient means of cutting production costs, reducing pollution and generating additional revenues depending on the ratio between the price of electricity secured and production cost of electricity generated in the sugar industry.

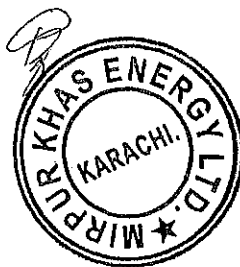
5 The Project

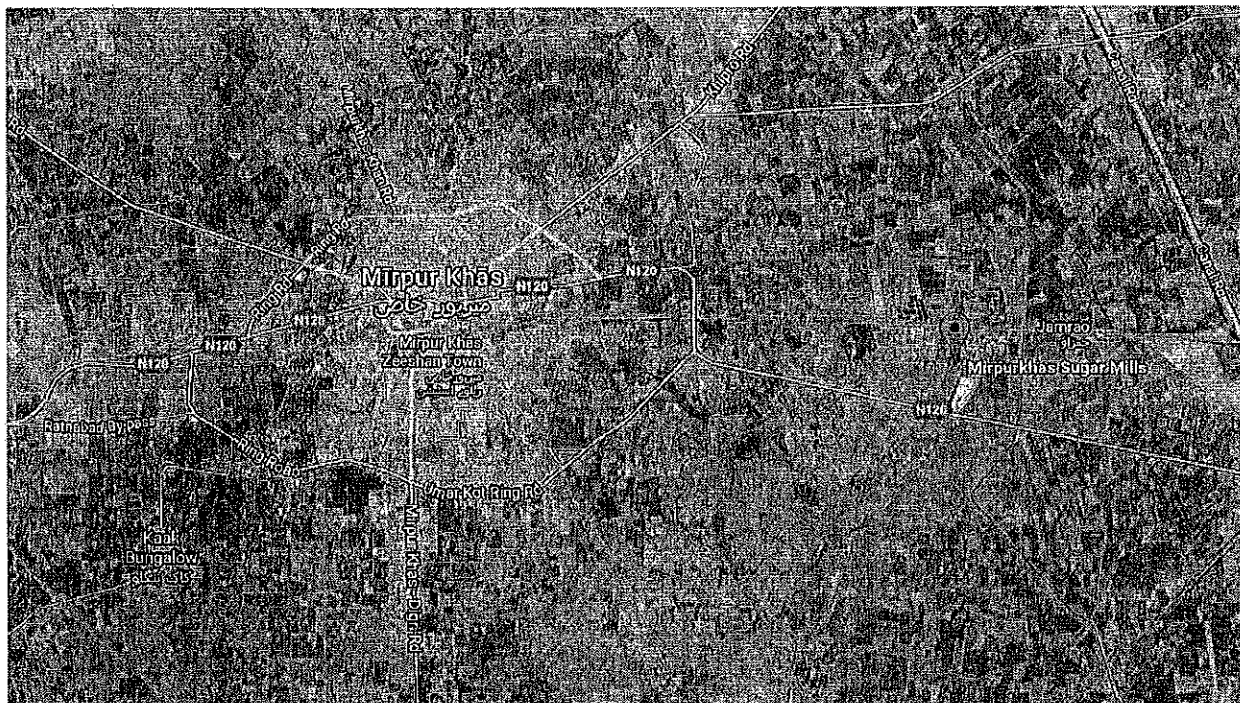
The 26 MW Co-generation Project envisages a 1+1 configuration power plant comprising of one high pressure (110 bar) traveling grate boilers, having a steam generation capacity of 130 tons per hour, and one condensing/extraction steam turbine generator having a capacity of 26 MW and balance of plant ("Plant"). It is planned that, **during the crushing period**, steam and power for MSML operations will be provided from the existing low pressure ("LP") system and the balance steam/power requirement of MSML will be met through the high pressure ("HP") system of the Plant. During the crushing period, bagasse from MSML will be utilized both in the HP and LP Systems to generate steam and power. (Note: Only power generated from the HP system may be sold to CPPA-G). During the non-crushing period, only the HP system shall operate, which will use un-utilized bagasse available with MSML as fuel.

5.1 Project Site and Location

The Project Site is adjacent to Mirpurkhas Sugar Mills Limited ("MSML") located at Jamrao, Umerkot Road, Mirpurkhas, Sindh. The adjacent area is owned by MSML and approximately 20 acres will be allocated to Mirpurkhas Energy Limited under a lease agreement for a period of 30 years plus construction period.

A map of the Project site map is given below and project layout has been attached as Annexure 1:





6 Plant Type and Technology

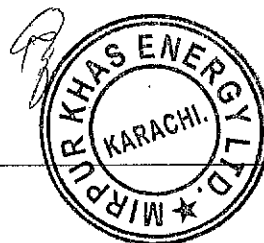
6.1 General Design

The design of the Facility is typical for a biomass-fired cogeneration facility which also is specific to the use of bagasse and to the cogeneration requirements.

The boilers will consist of tall water wall furnace with platen generators located at the top of the furnace. The super heater will have three stages. The first stage is a horizontal tube convective super heater located in the boiler second pass. The second stage consists of platens located at the top of the furnace adjacent to the generator section. The third stage consists of pendants located above the furnace arch between the second and first stages. Following the super heater will be three horizontal tube economizer sections and four tubular air heater sections.

The steam cycle consists of two high pressure feed water heaters and a Deaerator for each unit. The high pressure feed water heaters take steam from the two uncontrolled extractions of the steam turbine. Steam for the Deaerator is to be supplied from the controlled extraction of the steam turbine.

The Facility has two modes of operation defined by steam needs of MSML. During the crushing season, MSML needs steam and electricity to crush the sugar cane and produce sugar. Steam for MSML will be supplied from the controlled extraction of the steam turbine which is at approximately 3 bar (ab) pressure. The expected steam demand for MSML is 87.5 TPH from Cogeneration HP Power Plant. Total electricity demand of Sugar Plant during the crushing season is 9.21 MW out of which 4.01 MW will be supplied from Cogeneration HP Power Plant. During the off-season, the electricity demand is 0.5 MW.



6.2 Technology

Combustion technology based on the Rankine Cycle will be utilized in this project which is proven latest technology. The bagasse will be combusted in a high pressure boiler and the steam generated will be fed to the steam turbine to generate power. The turbine will be different from the conventional thermal power plants as the turbine will be provided with a controlled extraction for extracting the process steam required for the sugar mill. To enhance the efficiency of operation, regenerative heaters are used in the feed water circuit. For the cogeneration power plant proposed for MEL, the cogeneration cycle is based on the parameters of 110 bar(a) and 540 degree centigrade at the boiler outlet, currently being used in many countries for the cogeneration projects. The cycle chosen with the above parameters is the latest used in many of the bagasse fired installations around the world. These above selected parameters make the cycle more efficient and help in the generation of more units for the same quantum of the fuel.

There are already many Cogeneration plants operating in Pakistan & India with these parameters and the operating experience of those plants, in synchronization with the sugar mill operation, has been smooth and without any hitch. The Cogeneration scheme for MEL proposes 1x130 TPH capacity boiler and 1x26 MW extraction condensing turbo generators. Considering the offseason operation of the plant, the Cogeneration power plant boilers will be designed for firing the saved bagasse and a few other compatible bio-mass fuels.

7 Design and Specifications of the Plant

7.1 Bagasse Fired Boiler

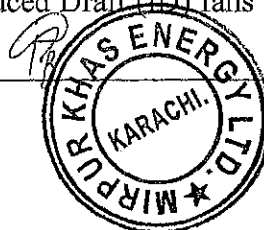
The Boiler shall be single drum, natural circulation, radiant furnace with water cooled membrane wall, three stage super-heater with two stage attemperator, balanced draft and travelling grate bagasse fired boiler. The boiler is capable of a peak generation of 110% of the MCR for a period of half an hour in eight hour shift. The boiler shall be top supported, outdoor type, with adequate provisions for the thermal expansion of the boilers in all directions.

Design Parameters:

- Bagasse Fired Boiler; 130 TPH
- Steam pressure at the Main Steam stop valve outlet: 110 bar(a)
- Steam temperature at the Main steam stop valve outlet at MCR: 540 ± 5 °C
- Boiler feed water temperature at the inlet to the Deaerator: 95 °C.
- Maximum noise level at 1.0 m distance for the boiler: 85 dB(A)

The Bagasse through drum feeders, screw feeders and pneumatic spreaders will be fed into the furnace. The travelling grate is selected for efficient combustion system and to avoid heating of grates. The Ash is collected by the continuous movement of travelling grate.

The air will be supplied by primary Forced Draft (FD) fans & secondary air fans. The air towards Bagasse and coal will be controlled by the fuel air control system in order to guarantee safe and optimum combustion. The air supplied from FD fan will be heated up in air pre-heater. The pressure in the furnace will be controlled by the Induced Draft (ID) fans installed at outlet



of boiler. These fans will be provided with Variable Frequency Drive (VFD) in order to optimize the power consumption. ID fans will discharge flue gases.

After complete combustion in furnace the flue gases shall enter the super heater section installed in the upper portion of the furnace. From the super heaters the flue gases will flow downwards into modular bank. The evaporator section of the boiler will be designed for a large circulation ratio. Even during quick plant load changes the water circulation will be stable and thus prevent steam blockage in the evaporator sections.

From evaporator section, the flue gas shall enter the bare tube economizer from the top and leave at the bottom to Air Flue Gas Pre-heater. The economizer tubes will be supported in the structure of the economizer casing and will be bottom supported. The economizer will be fully drainable.

Thereafter, the Fly Ash Arrestor installed at the outlet of the Air Pre-heater. From Fly Ash Arrestor most of the fly ash will be separated from the flue gases.

The condensate from the sugar mill shall be directly fed into the condensate tank from where it will be pumped to the Deaerator via sugar plant exhaust condensate pumps through a level control system.

Demineralized (DM) water will be supplied to the boiler for makeup. The makeup water will be pumped to the overhead surge tank via DM water distribution pumps. The makeup water will be added in the condenser hot well from the overhead surge tank by gravity through a level control system. The condensate from the condenser and makeup water added to the condenser hot well will be pumped to the Deaerator by condensate extraction pumps.

3x50% Boiler Feed Water (BFW) pumps shall be provided. BFW pumps are multistage, centrifugal type with low voltage 400-415V drive motors with Variable Frequency Drives (VFDs). The condensate and make-up water lines will have level control valve to control Deaerator level.

The control philosophy, boilers interlock and protection logic shall be implemented in Distributed Control System (DCS) for safe operation of boiler.

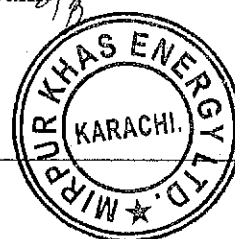
7.2 Steam Turbine and Auxiliaries

7.2.1 Steam Turbine

The turbine of the cogeneration power plant will be multistage nozzle governed, horizontal spindle, two bearings, and extraction cum condensing type with 03 number of uncontrolled extractions and 01 number of control extractions. The exhaust from the turbine will be condensed in the surface condenser at 0.101 bar (a) pressure during off-season operation.

The low pressure steam at 3 bar (a), 133.6°C will be supplied to the sugar plant for juice heating in the evaporator station. The medium pressure steam at 6 bar (a), 350°C will be supplied for centrifugal washing. 87.5% condensate of the supplied LP steam will be returned from the sugar mill. There will be no condensate return of medium pressures steam.

7.2.2 Gear Box



Heavy duty reduction gear box of Double helical type with hardened & ground gears will be installed, capable of transmitting maximum power generated by turbine and able to withstand 20% over speed over a period of minimum 5 minutes.

The gear box will be designed with a service factor of 1.3 as per AGMA requirements.

7.2.3 Couplings

High speed coupling between the turbine & the gear box will be non-lubricating, steel laminated, flexible type. The coupling between the gear box and the alternator will be low speed. Both the couplings will have coupling guards and acoustic covers. Power rating of the couplings shall be in accordance with AGMA 514

7.2.4 Condensing System

Condensing system shall comprise of the following:

- Shell & Tube horizontal type surface condenser with integral hot well, thermal relief valve and atmospheric relief valve.
- Steam Ejector system consisting of:
 - Twin stage main ejectors (1 working + 1 standby) with two surface type inter and after condensers.
 - Startup hogging type ejector with silencer.
- Vertical canister type Condensate extraction pumps (CEP's), with a 3 x 50% capacity with LT motors and suction valves.
- Rupture disc for condenser protection.
- Expansion bellow with spool piece between turbine exhaust and condenser inlet
- Dry air/vapor line within specified battery limit

7.3 AC Generator

AC Generator shall comprise of the following:

- Brush-less exciter with PMG
- Air coolers
- Twin bearings
- AVR cum Excitation panel
- Anti-condensation heaters
- Water leakage detector- 1 per cooler
- Lube oil flow regulator - 1 per bearing

Generator shall be supplied in line with the following specifications:

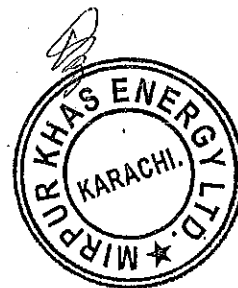


Table 6: Generator Specifications

Description	Parameters
Rating & Count	26 MW
Type	Synchronous type
Number of pole & Excitation System	Four pole, with brushless excitation system.
Power Factor	0.8PF (lagging) to 0.95(leading) under entire band of +10% voltage variation and +5% frequency variation
Insulation Class	Class 'F' insulation and shall be suitable for operation within class 'B' limits
Overload Requirements	Over loading of 110% for one hour every 12 hours and 150% for 30 seconds
Short Circuit and Overload Endurance	Generator shall withstand short-circuit of any kind at its terminal, while operating at rated load and 105% rated voltage for at least 3 seconds

7.3.1 Generator Protection and Control System:

Generation protection and control system will consist of the following equipment:

- Generator protection (Relay) Panel
- Metering & Synchronizing Panel
- MCC Panel
- Lightning arrestor, Surge capacitor and Potential transformer (LA, SC & PT) Panel
- Neutral grounding resistor (NGR) Panel
- DC Distribution

7.4 Governing System

The governor system provided will control the acceleration of the turbo generator and prevent over speed without tripping the unit under any operating condition or in the event of maximum load rejection.

The governor system will have the following important functions:

- Speed control
- Over speed control
- Load control
- Inlet steam pressure control
- Extraction pressure control

7.5 Lubrication and Control System

A single forced feed lubrication system will be installed for Turbine, Gearbox & Alternator comprising of the following major components:

- Lube oil tank
- Oil Vapor extractor
- AC Electric Main Oil Pump (MOP) driven by gearbox low speed shaft
- AC electric Motor driven Auxiliary Oil Pump (AOP)
- DC Motor driven Emergency lube Oil Pump (EOP) with auto cut-in & cut-out facility
- Lube oil coolers (1 working + 1 standby)
- Lube oil filters (1 working + 1 standby)
- AC motor driven oil mist separator mounted on oil tank

7.6 Control Oil System

Control oil system will comprise of the following:

- AC electric Motor driven Auxiliary Control Oil Pump (ACOP) (1 working + 1 standby) to supply oil to Control system.
- Control Oil filter (COF) (1 working + 1 standby)

7.7 Main Cooling Water Pumps

The cooling water system shall be designed to provide cooling water to the following area of the plant:

- Surface Condenser
- Auxiliary cooling water coolers

The cooling water system includes the following major components:

7.7.1 Main Cooling Water Pumps

Three (3) Main Cooling Water Pumps (two working and one standby) each of capacity approximately 2800 m³/hr shall be provided. Pumps will be horizontal centrifugal type, driven by electric motors.

7.7.2 Auxiliary Cooling Water Pumps

Two (2) Auxiliary Cooling Water Pump (One working and one standby) will be provided. Pumps will be horizontal centrifugal type driven by electric motors.

7.7.3 Cooling Tower System

The Cooling Tower System shall have the following specifications:

- One (1) R.C.C structure mechanically induced draft, counter flow type cooling tower
- Capacity of cooling tower will be approximately 5600 m³/hr and is combined and common for the whole cogeneration power plant.
- There shall be 2 cells each having a capacity of approximately 2800 m³/hr.
- The cooling tower will be designed for cooling of water from 42°C to 34°C, and an approach of 5-6°C while operating under the atmospheric wet bulb temperature of about

30°C.

- Each cell of cooling tower gear box will be equipped with vibration switches, oil temperature and oil level controls.
- The source of cooling water will be Bore Well Water.
- Cooling water supply and return temperature is 34°C and 42°C respectively.

7.8 Raw Water System

Raw water system consists off the following components:

7.8.1 Cooling Water Makeup Pump

Two (2) Cooling Tower make up Water Pumps for season and off-season operation will be provided.

7.8.2 Raw Water Transfer Pumps

Two (2) Raw Water Transfer Pumps (one working and one standby) each of capacity 20 m³/hr will be provided to ensure raw water supply to Water Treatment Plant.

7.9 Compressed Air System

The function of this system is to provide service and instrument air for cogeneration plant operations. Compressed air system provides air to following users:

- **Instrument Air Users:** Instrument air will be required for the operation of pneumatic instruments like I/P converters, purge instruments, pneumatic actuation of control valves, dampers etc.
- **Service Air Users:** Service air will be required for cleaning of filters, strainers and general purpose.

7.10 Bagasse Handling System

The bagasse handling system comprising of chain conveyors & belt conveyors to transport the required quantity of bagasse from sugar mill to cogeneration shall be provided. Bagasse from the sugar mill shall be fed to the boiler from a front mounted chain conveyor. Excess bagasse shall be returned to the bagasse storage yard. During off-season/non availability of bagasse from mill, the cogeneration boiler shall use saved bagasse from the storage yard.

7.11 Ash Handling System

The ash handling system envisaged for the cogeneration boiler shall consist of Submerged Ash Belt Conveyor System and Dense Phase Ash Handling System.

7.11.1 Submerged Ash Belt Handling System

Submerged Ash Belt Handling System consists of conveyor belts, drive assembly, all type of pulleys, all type of idlers, bearing assembly, inlet / outlet chutes, take-up assembly, trough assembly, support frames, cross over, walkway, structural safety switches, water inlet / outlet / drain nozzles etc. The bottom ash at the discharge of travelling grate shall be conveyed by submerged ash conveyor system.

The ash shall be quenched in the water trough of submerged ash conveyor before conveying. The submerged ash conveyor shall discharge the ash directly to a trolley mounted tractor for further disposal.

7.11.2 Dense Phase Ash Handling System

This system will handle fly ash from boiler ash hopper (other than traveling grate & plenum ash hopper) and ESP hoppers. Surge hopper (water cooled for boiler ash hopper and non-water cooled for ESP hopper) arrangement shall be provided below the boiler and ESP hopper. Two air compressors with built in PLC control system and 1x100% air receiver shall be provided near the dense phase equipment. The required conveying air for dense phase ash system will be supplied by these compressors through air receivers. The ash silo storage capacity shall be enough to store 12 hours ash generation from both the boiler and ESP system.

7.12 Water Treatment System

The Cogeneration power plant make up water requirements will be met from the bore wells located in the sugar plant. For the make up for the cycle, it is proposed to take the raw water through a Water Treatment Plant with the following treatment scheme.

2 x Multi-grade Filter → 2 x Two Stage Reverse Osmosis system → 2 x Electro De Ionization system. (2x MGF + 2xRO + 2x EDI) There shall be two independent streams. The capacity of water treatment plant is 70 m³/hr. DM water is collected in two DM water tanks each having a capacity of 700 m³. Water will be distributed from DM tanks through pumps to different users i.e. Deaerator, Condenser etc.

7.13 Firefighting System

The function of fire-fighting system is to supply water to the main risk areas of the cogeneration power plant.

The fire protection system is required for early detection, containment and suppression of fires. A comprehensive fire protection system shall be provided to meet the above objective and all statutory and insurance requirements of National Fire Protection Association (NFPA).

The fire-fighting system shall consist of the following:

7.13.1 Stand Pipe and Hose System:

Stand pipe and hose system shall be provided to cover the building and structures of the cogeneration plant. The system shall be designed as per the NFPA 14.

Standpipe shall have a hose of 65mm diameter with connection to a large supply of water. The hose connection shall be not less than 0.9m or more than 1.5m above the floor.

7.13.2 Fire Hydrant and Water Monitoring System

The hydrant system shall be provided to cover all areas. The system shall be designed as per NFPA 24. The system shall consist of over ground hydrant mains laid in rings, isolation valves, and stand pipes with hydrant valves (outdoor). A Hydrant shall be placed after every 40m.

7.13.3 Portable Fire Extinguishers:

Dry Chemical Powder, CO² and foam type extinguisher system shall be provided. The equipment shall be designed as per NFPA 10.

7.13.4 Automatic High Velocity Water Spray Nozzle System:

Automatic High Velocity Water Spray Nozzle System shall be provided along with deluge valve assembly for outdoor transformers in switchyard, generator & Turbine lube oil system area. The system shall be designed as per NFPA 15. The deluge valve assembly shall be UL/FM listed.

7.13.5 Fire Alarm & Detection System

Fire detection system for the power plant will provide early detection of fire and raise alarm. A comprehensive fire protection system shall be planned to meet the above objective and meet all statutory and insurance requirements of National Fire Protection Association (NFPA). A multitude of systems will be provided to combat various types of fires in different areas of the plant and all such systems for various areas shall form a part of a centralized protection system for the entire plant. Fire alarm system detection system shall be provided in following areas:

- Fire alarm and signaling in all electrical/instrumentation panel rooms in TG building
- Manual call points and Electric Horns in outdoor areas.

7.14 Effluent Handling System

Effluent handling system consists of the following main components:

7.14.1 Neutralizing Pit

Acid/caustic produced (if any) from Water Treatment Plant will be collected in neutralization pit. This effluent will be transferred to effluent pit after neutralization.

7.14.2 Neutralized Effluent Re-circulation cum Transfer Pumps

Two (2) Neutralized Effluent Re-circulation cum Transfer Pumps (One working & one standby) shall be installed at Neutralization pit to transfer effluents from Neutralization pit to Effluent pit in water treatment plant area.

7.14.3 Effluent Pit

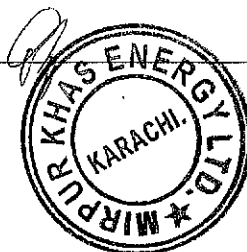
Effluents like Boiler blow down, cooling tower blow down, RO reject, MGF backwash, side stream filter flushing, RO flushing, neutralized effluent from neutralization pit, etc. shall be collected in the separate effluent pit near Water Treatment Plant area.

7.14.4 Effluent Transfer Pump

Two (2) Effluent Transfer Pumps (One working and one standby) will be installed on Effluent pit to transfer effluents. The pumps will also be used to re-circulate the effluent with in Neutralization pit for effective neutralization. The pump capacity shall be minimum 100 m³/hr.

7.15 Service Water System

Two (2) service water pumps (One working and one standby) will be installed to provide service



water to plant users. One (1) expansion vessel will be installed to keep service water header pressurized.

7.16 Electric Overhead Travelling (EOT) Cranes

EOT cranes shall be provided in the following buildings:

TG Hall

An Electrically operated EOT crane shall be provided for the erection and maintenance requirements of turbo generator and its auxiliaries.

The main hook capacity shall be 70 Tons and suitable for lifting single heaviest component in Turbo Generator. The auxiliary hook lifting capacity shall be of 10 Tons. The crane travel will cover the entire length of the TG building. The crane shall be electrically operated, bridge type and shall be designed and equipped for indoor operations complete with all accessories. The crane bridge shall consist of bridge girders each carrying a rail on which a wheeled trolley is to run. Operation of crane shall be by pendant type push button station from ground level.

Workshop and Store

An Electrically operated EOT crane shall also be provided for routine maintenance activities and store material handling to be carried out in the building.

The single hook crane capacity shall be 70 Tons. The crane travel will cover the entire length of maintenance bay of workshop. Operation of crane shall be by pendant type push button station from ground level.

8 Electrical Design

8.1 Electrical Network

The Plant shall consist of one generator and associated auxiliaries for smooth plant operation. A synchronous alternator for the proposed co-generation power plant with generation at 11 kV will be connected to 132kV system through 11kV switchboard and step-up Power Transformers.

The connection between generator and 11kV switchboard shall be through Isolated Phase Bus Duct and between 11kV switchboard and 11/132kV power transformer shall be through 11kV HT XLPE cables.

The generator will operate in parallel with NTDC National grid. A portion of the power generated in the turbo-generator will meet the power requirements of the Cogeneration plant auxiliary loads and the sugar plant loads through step down transformers.

The surplus power, after meeting the power requirement of cogeneration plant auxiliaries and sugar plant auxiliaries, shall be exported to the grid through 11/132kV power transformer. There shall be total of 2 step-up power transformer (one standby + one working)

Entire power evacuation system and associated equipment shall be designed so as to export the entire power from cogeneration plant (total generation less auxiliary power consumption), when the sugar plant is not in operation.

All the existing sugar plant loads shall be fed through one (1) interconnecting VCB Feeder.

8.1.1 Ambient Conditions for Electrical Equipment

Ambient conditions and design temperatures for electrical equipment are given in Table 7 below:

Table 7: Ambient Conditions for Electrical Equipment

	Deg C
Maximum Temperature	50
Minimum Temperature	8
Plant Design Temperature	44
Indoor Equipment Design	35
Outdoor Equipment Design	50

8.2 Plant Operating Voltage

The plant shall be designed suitable for operating at a frequency of 50Hz, with voltage levels of various systems of the plant as given in Table 8 below:

Table 8: Plant Operating Voltage

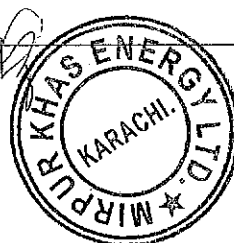
Generation (TG) system	11 kV
Power evacuation system	132 kV
Non-AC VSD / auxiliaries of cogeneration plant	415 V
AC VSD / auxiliaries of co-generation plant	415 V
DC system of co-generation plant	110 V
UPS system of co-generation plant	220 V

8.3 Basic Electrical Design Parameters

Basic electrical design parameters for the Plant are given in the table below:

Table 9: Basic Electrical Design Parameters

Power Factor (lagging)	0.8
Generation Voltage (kV)	11kV, 3 phase
Parallel operation with Grid	Required with 132kV grid
Grid Voltage	132 kV, 3 phase
System Frequency	50 \pm 5%
System Voltage Variation	\pm 10% Variation of Rated Voltage
System Fault Level	
132 kV	40kA
11 kV	40kA
400 V	50kA
Fault Level & Withstand Duration	
132kV Switchgear	40kA for 1 sec



For 11 kV Switchgear	40 kA for 3 sec
For 400 V Switchgear	50kA for 1 sec
400V Lighting System	5kA for 1 sec
11kV Isolated Phase Bus Ducts	40 kA for 3 sec
110VDC	3kA for 1 sec
48VDC	1kA for 1 sec
230VAC	3kA for 1 sec
Transformer and all accessories	All transformers and its accessories shall be capable of withstanding for 5 seconds short circuit at the terminal
Earthing System	
132 kV	Effectively earthed
11 kV	Neutral grounded (limited to < 50 A) / Unearthed (Whenever the generator is not in service)
400 V	Effectively earthed
110 V DC	Unearthed

8.4 132kV Switchyard

Switchyard shall be supplied for interface with NTDC Grid in line with following specifications and NTDC requirements. Detailed specifications of the switchyard are given in the table below:

Table 10: 132kV Switchyard Specifications

Voltage Level	132kV
Service	Outdoor AIS with SF6 circuit breakers
Number of Bays	2 OHL Bays 2 Transformer Bays 1 Bus-Coupler Bay
Bus Bar	AAC conductor of "Hawthorn"
Short Circuit SF6, gang operated	3150Amp 40kA 1sec
Isolator (Centre break, motor operated with copper alloy blades)	3150 Amp
Protection & Metering	As per NTDC Requirements
Highest System Voltage(kV rms)	145 kV
Power frequency withstand capability (kV rms)	275kV
Basic insulation level (kV peak)	650 kV
Creepage distance for insulators (mm/kV)	25mm
Instrument Transformers	Hermetically sealed, dead tank design. Rating as per SLD
Insulator	Brown glazed with min 6kN cantilever Strength
Towers & Support Structures	MS galvanized lattice type
Tariff Metering equipment	Three elements four-wire configuration, electronic, digital, with accuracy class of 0.2S; 30 minutes intervals for a period of 70 days with

	intervals programmable from 5 minutes to 30 minutes
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8.5 Isolated Phase Bus Duct

Generator shall be connected to 11kV panel through Isolated Phase Bus Duct with Aluminum conductors. All other electrical distribution connections shall be through MV or LV rated cables as per application and voltage grade. Technical details of the Isolated Phase Bus Duct are given in the table below:

Table 11: Insolated Phase Bus Duct Specifications

Application	Steam Generator Connection to 11kV Panel
Power Frequency Withstand Voltage	28kV
BIL	75kVp
Enclosure	Minimum thick of 3mm
Sizing Basis	Maximum through fault current either from 132kV grid or from the generator including contribution from total plant loads through Auxiliary Transformers with 20% margin on higher side or 50kA, whichever is higher

8.6 11kV Switchboard

Switchboard rated 11kV IP4X 3150Amp 40kA for 3 sec shall be provided for feeding transformers and connection to steam generator.

8.7 400 V Switchboard

All the cogeneration plant auxiliary loads shall be segregated into two groups, each consisting of AC Variable Speed Drive (AC VSD) driven loads and non-AC VSD driven loads.

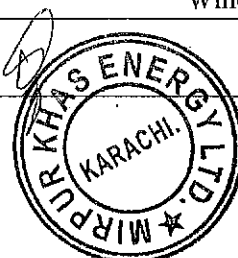
All AC VSD loads and non-AC VSD loads pertaining to cogeneration plant shall be connected to two (2) AC VSD transformers. Common systems like cooling water [main & auxiliary cooling water pumps and cooling tower fans] shall be distributed uniformly on both VSD transformers.

8.8 Transformers

Technical specifications of the different transformers to be installed in the Project are given in the table below:

Table 12: Specifications of Transformers

Description	Parameters
Generator transformer (GT) / Power Transformer	28/35MVA, 11kV/132kv, YNd1
VSD transformers [Three winding transformer] for co-generation plant	2x4 MVA 11kv/0.415/0.415 kV, Dzn0yn11 Dyn11
Lighting Transformer	Cast Resin Encapsulated 200kVA, 0.4kV/0.4kV, 50Hz, Dyn11, ONAN, Three Phase, Two Windings



Neutral Grounding Transformer	Yd windings, 50A for 10Sec & 500A for 3Sec, 11KV, ONAN
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8.9 AC & DC UPS System

AC and DC UPS system will be supplied for loads that require un-interrupted power. Following UPS shall be supplied for this purpose:

Table 13: AC & DC UPS Specifications

Description	Parameters
110VDC	2x100% Dual Redundant UPS with Dedicated Battery Bank [SMF type: Sealed Maintenance Free]
230VAC UPS	2x100% Dual Redundant UPS with Dedicated Battery Bank [SMF type: Sealed Maintenance Free]
Lighting 230VAC UPS	1x100% UPS with single battery bank [SMF type: Sealed Maintenance Free]

8.10 Control Philosophy & Interfacing

Critical and important electrical loads shall be interfaced with SCADA system [built in plant DCS] for local and remote operation in-line with plant operational & safety requirements.

8.11 Energy Management System

The incoming and outgoing feeders of 132kV Switchyard Bays, Main MV [PCC] Panel and AC-VSD panel outgoing feeders shall be provided with PQM/TVM with communication port suitable for MODBUS-RTU protocol. One daisy chained link shall be provided for each switchboard which will communicate soft data to Plant DCS. All these meters shall be hooked up to a dedicated Energy Management System for data logging built in plant DCS.

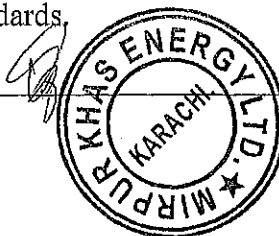
Communication ports of MODBUS - RTU shall be planned in all TVMs and PQMs provided in the PCCs, AC VSD panels and control panels of the TG, Generator Transformer and switchyard control and relay panels. All the ports shall be hooked up to Energy Management System (Part of DCS) for data logging as well as monitoring purposes. The mimic representation of the complete electrical distribution shall be provided in Energy Management System (part of DCS) from 132 kV level to major/main LT panels.

8.12 RTDs & Thermistors

Thermistors shall be installed on motors rated between 7.5 to 300 kW. RTD shall be made available for motors more than 300kW. All RTDs shall be hooked up with relays in Motor Relays in respective MCC.

8.13 System Earthing

The grounding installation work shall be as per recommendation of IEEE-80. All panels, transformer, LAVT, NGR and motors shall be provided with double earthing. Lightning protection for tall structure shall be in line with IEC standards.



132kV system shall be solidly grounded through 132 kV side of transformer neutrals at NTDC side as well as neutral of generator transformer on 132 kV side at co-generation plant.

TG system shall be grounded through Neutral Grounding Resistor (NGR) panel to limit the earth fault current to 50A to suit the system requirement, through the 11 kV neutral point of TG. The 11kV system shall be provided with 11 kV Earthing Transformer and Neutral Grounding Resistor (NGR) panel to limit the earth fault current to 50A. This NGR of earthing transformer shall be switched ON whenever the power is imported from the grid with TG circuit breaker in open condition. The 11kV system at the secondary side of Interconnection Transformer shall be provided with NGR grounding to limit earth fault current of 50 A.

LV system 400V system shall be solidly grounded through transformer neutral. Neutral busbars shall be made available in 400V PCCs, and all MCCs.

415V VSD transformer grounding system shall be as for 12 Pulse AC VSD drives – Solidly grounded.

415V system used for illumination system and small power distribution system shall be solidly grounded.

UPS System shall be of insulated neutral type (ungrounded). DC System shall be of ungrounded type.

8.14 Cable Installation

Cables shall be installed in concrete cable trenches [installed on trays], on cable racks and direct buried as required.

8.15 Cable Trench

Concrete cable trenches shall be fitted with ventilation fans, air inlets, normal lighting, emergency lighting, utility sockets, fire alarm detectors, manual call points, and annunciation sirens. All wiring shall be in GI conduits.

Trench shall have access inlets provided with ladders, slopped on two sides having water excavation pits and two pumps.

8.16 Lighting & Small Power

Plant lighting loads shall be fed through one No of 400/400V, Dyn11 connected dry type lighting transformer of minimum rating of 200kVA.

Emergency Lighting Distribution Board (ELDB) shall be fed through inverter of minimum 100kVA rating.

The number of sockets [where maintenance & operation is required] shall be provided in the indoor area in such a way that approachable distance of any socket is not more than 10M distance. Minimum four (4) nos. of 24V lighting kit shall be provided for the plant.

63A power and welding socket shall be provided in all indoor as well as outdoor area wherever maintenance of mechanical equipment is required. Each socket shall comprise of MCB with ELCB and power / welding socket.

8.17 Plant Communication System

Plant communication shall be provided with following facility:

- Telephone system
- Public Address System
- Walkie-talkies.

8.18 Enclosure Ratings

Enclosure IP ratings for different applications shall be as below:

Table 14: Enclosure Ratings

HV Switchgear	IP4X
LV Switchgears	IP4X
Switchgears located outdoors	IP55
Control Panels	IP42
Motors	IP55
Push Button Stations	IP54 (indoor) IP55 (outdoor)
Isolated Phase Bus ducts	IP54 (indoor) IP55 (outdoor)

8.19 Plant Startup

The co-generation plant shall be started with two (2) numbers of 400V Black start DG sets. These DG sets shall be connected to DG panel, which shall be planned with two incoming DG set feeder and five outgoing feeders.

Plant startup can also be managed either from Grid supply or existing plant sugar mill feeder. In either case power shall be available at the main 11kV MV Panel. Through respective step down distribution transformers power shall be fed to desired STG auxiliaries and common co-generation plant loads.

The DG set shall be with radiator cooled type. Proposed rating of DG set shall be 1500kVA at Prime duty.

8.20 Instrumentation and Control (I&C) Systems

I&C System will ensure control and monitoring of operations of both the technological and electrical part of Cogen Power Plant including balance of plant (auxiliary operations) and 132 kV switchyard. Control room and its auxiliary equipment will be located in an outbuilding (CCR) adjacent to the Turbine Hall. I&C System will be designed as a complex system capable to control the whole Cogen unit both in standard conditions and transient operating conditions

(start-up, shutdown, etc.). Specific autonomous functions of protections and control for steam turbines will be performed by their dedicated control system, nevertheless this dedicated control system will be an integral part of the whole I&C System from the viewpoint of operation, monitoring and control. I&C System, as a whole, will ensure control and monitoring of the following equipment:

- Boiler and its Auxiliaries
- Fuel Handling System
- Ash Handling System
- Steam turbine with accessories
- Balance of plant
- Electric equipment of Switchyard

8.21 Digital Control System (DCS)

The controlling and monitoring of operation of main power unit, loading and synchronizing, balance of the plant will be provided from the common control room through the operator panels of the process, electrical part including power outlet equipment, frequency control and switchyard etc. The working place of the system operator will be placed at the control room. The working place of shift engineer will be located in separate room with the window to control room. The DCS will be based on fully redundant process and network bus. The power plant will be fully automated with a target of high operation reliability as well as high operation safety. Control system will fulfill required standard functions for securing optimal, economical, safe and ecological operation for installed equipment in nominal and transient operation conditions. System will cover control function from basic level control up to fully automated control of function groups and units, control of system output and optimization of block operation. Specific autonomous functions of the plant safety system and selected regulation and control functions will be realized by special subsystems in a hierarchical model. From a viewpoint of control, these items will create an integrated part of the DCS control system.

Hardware and software will enable realization of loop control, binary control, data functions, monitoring, remote control and emergency manual control. Communication within the system will be handled by bus routing connected to the standard bus system RS 485, Ethernet etc.

8.22 Field Instrumentation

Instrument power circuits will employ an isolation transformer and will be individually protected from fault with the help of MCB's and fuses. Power supply to the individual instrument will be disconnect-able with the help of switch and will be protected with the help of fuse.

All instruments and equipment will be suitable for use in a hot, humid and tropical industrial climate. All instruments and enclosures in field will be dust proof, weather proof of type NEMA 4 and secured against the ingress of fumes, dampness, insects and vermin. All external surfaces will be suitably treated to provide anti-corrosion protection.

The complete instrument system will be designed for safe operation, by using normally closed contacts which open on fault conditions.

The operating value of field instrument will fall between 40% and 60% span for linear and 60% to 80% span for square root.

Transmitter valve manifold block assemblies will be type 316 stainless steel unless process conditions require higher-grade material. Internal wetted parts will be type 316 stainless steel unless process conditions require use of other material.

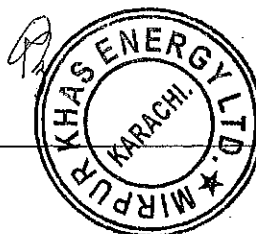
Process switches e.g. pressure switch and level switch will be of micro switch type.

All field-mounted instruments will be equipped with sufficient isolation device such as a block and bleed valves assembly, and vent and drain valves so as to permit safe maintenance, removal, testing and calibration of instruments during plant operation.

9 Grid Interconnection

A detailed grid interconnection study for the Project has been carried out by Power Planners International and submitted to HESCO for approval. Key findings of the report are summarized in this section.

- The network around MEL at 132kV and 11kV has been modeled as shown in Annexure-2 (Sketch 1).
- The nearest HESCO grid facility available for interconnection to MEL is Mirpurkhas-2 132 kV grid station and Samaro 132 kV grid station.
- Keeping in view the location of the Project, it is proposed to connect MEL via looping in-out of the existing transmission line from 132 kV Samaro grid station to Mirpurkhas-2 132 kV grid station.
- The looping distance, as confirmed from site visit, would be 2 km and the conductor used would be Lynx. The scheme is showed in Sketch-2 attached as Annexure 3.
- MEL would generate power at 11 kV voltage level from where it will be stepped up to 132 kV using two 132/11 kV transformers with rating of 31.50/40 MVA.
- The proposed scheme would require two 132 kV line bays at the 132 kV substation of MEL for the connection to 132 kV Samaro grid station and Mirpurkhas-2 132 kV grid station.
- Furthermore, it would also require two transformer bays for the connection of two 132/11 kV transformers with rating of 31.50/40 MVA.
- The above proposed interconnection scheme has been tested for steady state conditions through detailed load flow studies for the peak conditions of:
 - January 2019 for maximum thermal power dispatches in the grid during the Crushing Season for MEL
 - September 2019 for maximum hydropower dispatches in the grid during the off-season for MEL
- The system conditions of normal and N-1 contingency have been studied to meet the reliability criteria of NEPRA Grid Code.
- The proposed scheme of interconnection has also been tested for the extended term scenario of peak load conditions of the year 2021 for steady state conditions.



- Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the spillover of up to 23.50 MW power of the Plant under normal as well as contingency conditions.
- The short circuit analysis has been carried out to calculate maximum fault levels at MEL and the substations of 132 kV in its vicinity.
- The fault currents for the proposed scheme are within the rated short circuit capacities of switchgear installed at these substations.
- There are no violations of exceeding the rating of the equipment due to contribution of fault current from MEL. The maximum short circuit levels of MEL 132 kV is 8.99 kA and 9.17 kA for 3- phase and 1-phase faults respectively for the Year 2019 and 9.37 kA and 9.47 kA for 3-phase and 1-phase faults respectively for the Year 2021.
- It has been advised to utilize standard size switchgear of short circuit rating of 40 k, which would provide large margin for any future increase in short circuit levels due to future generation additions and network reinforcements in this area.
- The dynamic stability analysis of proposed scheme of interconnection has been carried out for January 2019.
- The stability check for the worst case of three phase fault right on the 132 kV bus bar of MEL substation followed by the final trip of one 132 kV circuit emanating from this substation, has been performed for fault clearing of 5 (100 ms) and 9 cycles (180 ms), in case of stuck breaker, as understood to be the normal fault clearing time of 132 kV protection system. The stability of system for far end faults of 3-phase occurring at 132 kV bus bar have also been checked.
- The proposed scheme successfully passed the dynamic stability checks for near and far faults for the most stringent cases. The system is found strong enough to stay stable and recovered with fast damping. The proposed scheme of interconnection has no technical constraints or problems, it fulfills all the criteria of reliability and stability under steady state load flow, contingency load flows, short circuit currents and dynamic/transient conditions; and is therefore recommended to be adopted.

10 Environmental Impact Assessment

MEL has commissioned an Initial Environmental Examination ("IEE") to identify and assess any adverse impacts of the Project, so that necessary mitigation measures, if required, to prevent or minimize any adverse impacts can be planned in a timely and cost-effective manner. The specific objectives of the report were:

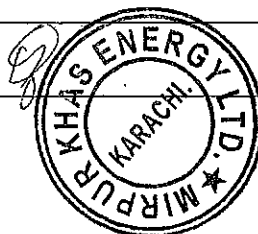
1. To have an in-depth know-how of the Project and to identify the probable sources of pollution that may arise from each stage of the process.
2. To review the current environmental status of the area within 10 km radius of the proposed Project site - collection of baseline data on the environmental attributes including air, noise, water, land, ecological, hydro-geological climate and socioeconomic environments.
3. To assess likely or potential environmental impacts of the proposed activity (like air, water and soil pollution, noise, waste generation) and the alternatives.
4. To estimate the impacts of the proposed Project on the surrounding environment.



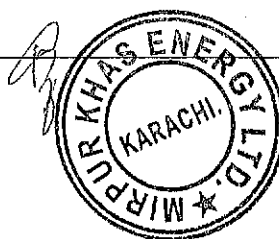
5. To prepare a comprehensive Environmental Management Plan to ensure that the environmental quality of the area is preserved.
6. To formulate a strategy for effective monitoring and identify any deviations in the environmental quality after the project is operational, which would help in evolving measures to counter these.
7. The IEE is to be undertaken pursuant to the Pakistan Environmental Protection Act 1997, the Sindh Environmental Protection Act 2014.

Summarily the IEE report has identified the following impact on the environment, suggested activities to cushion the impact and consequences thereof:

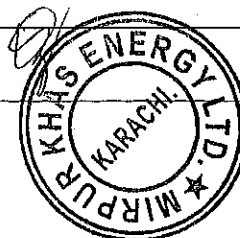
Impact on the environment	Suggested cushion activities	Residual impacts	Level of residual impacts
Impact on the landscape and the exterior view	<ul style="list-style-type: none"> None of activities are suggested, as the surrounding landscape is the industrial one. The time of construction is limited. 	<ul style="list-style-type: none"> No 	Insignificant positive impacts
Impact on the atmospheric air	<ul style="list-style-type: none"> Development of procedures on irrigation of road surface before the construction work begins; material storage in piles to minimize dusting. As far as necessary use closed trucks to transport discrete materials from the site in order to prevent dispersion by transportation. 	<ul style="list-style-type: none"> Dusting in the course of construction work The impact is significantly reduced 	Insignificant negative impacts
Water pollution as a result of possible leakage of fuels and lubricants and chemical substances in the course of the construction work.	<ul style="list-style-type: none"> To allot a special ground with a protection from leakages for the purpose of storing potentially polluting substances. Development of working instructions to guarantee the right treatment of these materials. 	<ul style="list-style-type: none"> Impact risk is significantly reduced 	Insignificant negative impacts
Waste generation by the construction work	<ul style="list-style-type: none"> Development of procedures of waste control and storage to guarantee the right identification of waste, rules of storage safety, reuse or recycling, where the transportation to the special site is possible. 	<ul style="list-style-type: none"> Generation of construction Waste Reducing waste volumes which are to be buried in the course of the assumed activities. 	Insignificant negative impacts



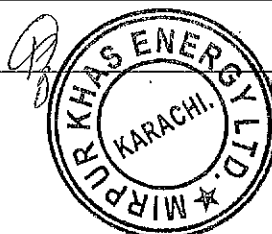
Noise	<ul style="list-style-type: none"> • Development of the plan to control noise. It may include: • Switch off plants and facilities when they do not work. • Determine the site working hours. • Develop a work program to minimize the work during the non-working hours (not daytime). • A brief instruction of all workers about the noise control measures. • Use temporary screens or partial enclosure of the territory, where the activity takes place. 	<ul style="list-style-type: none"> • Reducing the level of noise impact. 	Insignificant negative impacts
Impact on the atmospheric air	<ul style="list-style-type: none"> • Development of normative standards of maximum permissible emissions for the sources of all pollutants, providing the correspondence of near the ground concentrations at the bounds of sanitary protective zone to the maximum permissible concentrations. • Development of activity on the emission regulation during the period of unfavorable meteorological conditions. • Organization of permanent control after pollutant emissions into the atmosphere with the application of the results of planned observations. 	<ul style="list-style-type: none"> • After putting the plant into the operation the concentration of most pollutants in the atmospheric air remain the same or decrease. • The emission of green greenhouse gases decrease. 	positive impact
Possibility of emergency developing	<ul style="list-style-type: none"> • Surface air monitoring at the bound of the sanitary protective zone and the zone of facility influence. • Possibility of emergency developing Investigation of the whole range of possible measures and means, which may be 	<ul style="list-style-type: none"> • Operation of the proposed plant may increase danger. However, the creation of environmental safety management system, representing the aggregate of juridical, 	Insignificant positive impacts



	<p>opposed to the dangerous factors with the purpose of their parrying within the advantages of the environmental safety.</p> <ul style="list-style-type: none"> Quantitative analysis of the possibilities for one or another situation to appear, of effectiveness of different measures and means of their parrying. Creating the system of a complex monitoring and management of environmental safety. Taking a complex of decisions, that excludes depressurization of facilities and preventing emergency emissions of dangerous substances as well as reducing corrosive attacks of pipelines and shut-off-and-regulating fixtures. Proving disclosure means to control emergencies. Development of fire prevention activities. Having a plan of work on liquidation emergency spill of fuel, lubricants and mazut. Development of procedures on preventing emergencies (including fire, spills, etc.) Provide the respective training for personnel and give out the necessary equipment. 	<p>organizational and economic mechanisms, intended to decrease the environmental risk to the acceptable level, and in case of emergency with an impact on the environment to provide security to people and to the environment, will help to achieve the maximum reduction of possible damage and compensation of the caused loss.</p>	
Impact on surface-waters	<ul style="list-style-type: none"> Application of separate system of sewage disposal Application of modern systems of water treatment, grounded on the analysis of sewage quality. Monitoring the condition of water from the surface sources. 	<ul style="list-style-type: none"> The impact on surface-water is minimized 	Insignificant positive impacts



	<ul style="list-style-type: none"> • Quality control of entering and exporting of sewage. • Liquidation plan correction of oil product overflows and its approval. 		
Impact on soils	<ul style="list-style-type: none"> • Mechanical removal, storage into piles and clamps as well as soil replacement with a qualitative one. • Organization of specialized places to exclude the soil contact with the substances of higher danger. • Development of the complex of activities which exclude the possibility for oil products to leak on the soil surface. 	<ul style="list-style-type: none"> • Soil quality improvement at the expense of the replacement of degraded soil with a qualitatively new one. • The possibility of potential soil pollution being a result of oil spill is insignificant due to the application of preventive measures complex. 	Insignificant positive impacts
Waste generation	<ul style="list-style-type: none"> • Permanent monitoring of the waste disposal places. • Approval (renewal) licenses and permissions on waste treatment. • Having approved instructions on collecting, storing and transporting the production waste. • Making records of all data about the delivered and recycled waste and providing the respective reports. • Waste sorting out and storage with account of the direction of its finale usage. • Marking of containers, used for waste collection and storage, as well as registration in respective documents of such data as a source of waste products, their quantity, a danger class, a collection date and a date of disposal at the production facility with the purpose of 	<ul style="list-style-type: none"> • Insignificant change of qualitative and qualitative composition of waste • Waste impact on the environment is assessed as insignificant under the condition of realizing the developed projected decisions concerning the rules of temporary storage and established frequency of their removal to recycling and disposal. 	Minimum positive impact



	<ul style="list-style-type: none"> storage. Maximum possible replacement of toxic materials with less dangerous. Sorting out according to the classes of danger with the subsequent waste separation depending on the type. Activities on reducing the amount of generated waste. 		
Impact on ground waters	<ul style="list-style-type: none"> Development of measures against leakage from reservoirs and from the underground water-bearing communications. Development of the system of hydrogeological monitoring. 	<ul style="list-style-type: none"> The possibility of the impact on the ground waters is small. 	Minimum positive impact
Impact on flora and Fauna	<ul style="list-style-type: none"> Accomplishment of the works on landscaping. 	<ul style="list-style-type: none"> Landscaping work will allow to extend the area of greenery. 	Minimum positive impact
Impact on the geological environment	<ul style="list-style-type: none"> Speeding up the construction terms and observing the recommendations of the IEE (EMP) section, which exclude pollutants entering into the open trenches and pits. Monitoring of the impact on the geological environment. 	<ul style="list-style-type: none"> The subsidence of buildings in the course of use of buildings and constructions is expected to be minimum and short-term. The impact of vibrations and impoundment of areas is extremely insignificant. 	Extremely insignificant negative Impact
Social impacts		<ul style="list-style-type: none"> Creating additional jobs. Increase of employee incomes and population purchasing activity due to procurement of materials and supply of services for construction necessities. 	Positive impact

11 Operations and Maintenance (O&M)

The Facility will be a standalone operation under the management of the Plant Manager who shall be in charge of both technical and administrative functions of the co-generation facility's operation and maintenance. Most operation and maintenance functions will be performed by permanent staff; however, certain functions, such as performance monitoring of equipment, environmental monitoring, fuel yard operation, ash handling and major maintenance, will be performed under various contracts with specialized vendors. The contracts will be equipment specific performance monitoring and maintenance contracts and will also include contracts for supply of manpower for major maintenance activities. To the extent practical, the operation of the Facility will be automated through a distributed control system.

The Facility operation is planned to be divided into three shifts with a fourth shift in reserve. Each operating shift will include a shift charge engineer, one control room operator, one operator, one boiler operator two field operators and a chemist. All the operations staff will report through the shift charge engineers who report to the Operations Manager reporting to Plant Manager

The maintenance of the Facility will be divided into three work areas – instrumentation, electrical, and mechanical. Each work area will be managed by a manager who reports directly to the Plant Manager. Maintenance staff reporting to the managers will be provided on each shift. The total maintenance staff is as follows:

The maintenance staff will perform the routine maintenance on the Facility. During the off-season periods when the Facility is not operating, the maintenance staff will support any major maintenance work that needs to be performed.

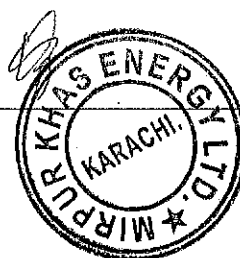
In addition to the operation and maintenance departments, there will be a separate performance department and a fire and safety department. The staffing for these two departments is as follows:

Table 15: O&M Staffing

Mechanical Maintenance		Electrical Maintenance		Instrumentation & Control	
Manager – Mechanical	1	Manager – Electrical	1	Manager – I&C	1
Mechanical Engineer	1	Electrical Engineer	1	I&C Engineer	1
Mechanical Supervisor	1	Electrical Supervisor	1	I&C Supervisor	1
Mechanic/Fitter	8	Electrician	5	I&C Technician	5

The performance/efficiency engineer will be responsible for monitoring the operation of the Facility and identifying any operational issues that affect the performance of the Facility. Additional responsibilities include maintaining the plant design records and drawings.

Hence the total operation and maintenance staffing, including the Plant Manager, is 64. This excludes the contract operation and maintenance staff.



11.1 Periodic Maintenance

Routine maintenance of the Project will be performed on a shift basis. Most of the routine maintenance activities are expected to be preventative maintenance work and troubleshooting during the time the Facility is operating. There will be some time during the off-season where the Facility will not be operating due to unavailability of bagasse or other appropriate biomass fuels. During these non-operating periods, which shall last up to one month during a given year, the maintenance staff can perform more extensive repairs.

The major maintenance cycle for the key components will be a function of the number of operating hours accumulated. Given the expected downtime during the off-season, it is logical to expect boiler inspections, cleaning and repairs to be performed each year. The annual boiler work would include measurement of tube thickness in certain areas of the boiler, weld repairs where there is localized tube metal loss, tube replacements where the metal loss is more extensive, refractory repairs, grate bar replacements, grate chain adjustments, ash system repairs, etc. Extensive repairs would not be required for the first ten years of operation, particularly if the fuel burned is primarily bagasse and the operating period is less than 180 days a year.

Major maintenance on the steam turbine and generator is to be performed on a five to seven year basis for a base loaded plant. A thorough inspection of the steam turbine and generator is expected prior to the expiration of the supplier warranties. After that, given the expected operating regime of approximately 180 days per year, the first major inspection of the steam turbine and generator would not be anticipated for ten years unless there are indications of some mechanical or electrical failure.

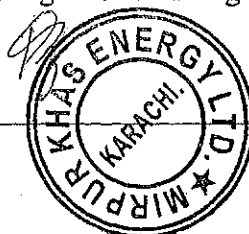
12 Key Operating Assumptions

The following sections provide a summary of the general, project cost, operating and financing assumptions related to the Project. The feasibility has been prepared following a detailed discussion of these assumptions with Project sponsors. The proceeding sections discuss the following assumptions:

- Plant Generation
- General & Timeline
- Project Cost
- Financing Assumptions
- Project Tariff & Revenue
- Operating Cost Assumptions (including fuel)

12.1 Plant Generation Parameters

As discussed earlier, 26.00 MW steam turbine generator shall be provided steam by the HP boiler. During the crushing period, the HP boiler and steam turbine shall meet the steam and power requirements of MSML to the extent these are not met by the LP boiler. To meet the steam requirements of the MSML process, the current LP boiler along with a 5.2 MW (Net) backpressure turbo generator shall be operational during the crushing period. The steam



generation through the LP system shall only be available during the season and will be dedicated to the sugar mill. Key generation parameters during are as follows:

Table 16: Plant Generation

	Crushing Period	Non-Crushing Period
Extracting & Condensing Turbine Capacity	25.50 MW	26.00 MW
Auxiliary Consumption of Turbine	2.27 MW	2.21 MW
Net Capacity from HP System	23.23 MW	23.79 MW
Gross Capacity of Backpressure Turbo generator	5.70 MW	n/a
Auxiliary Consumption of Backpressure Turbo generator	0.50 MW	n/a
Net Capacity of LP System	5.20 MW	n/a
Sugar Mill Requirement	9.21 MW	0.50 MW
Net Exportable to Sugar Mill from HP System	4.01 MW	0.50 MW
Net Exportable to Grid from HP System	19.22 MW	23.29 MW
Exportable Units	46,682 MWh	46,933 MWh

12.2 Project Timeline

As per discussions with the Sponsors a 20-month construction time following financial close has been assumed for the Project. Financial Close is targeted in end July-early August 2017 with a target Project commercial operations date (“COD”) of end-March 2019. This would enable the Project to smooth any teething issues that may arise during the crushing period. A schedule of activities and key milestones is provided in Table 17 below.

Table 17: Indicative Project Schedule

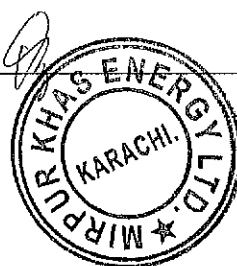
Activity	Duration	Start Date	End Date
Issuance of LOI			8-Nov-16
EPC Activities	120	8-Nov-16	8-Mar-17
Grid Study, Approvals & CPPA-G Consent	120	8-Nov-16	8-Mar-17
Generation License Application and Approval from NEPRA	60	16-Jan-17	17-Mar-17
Tariff Application and Approval from NEPRA	30	8-Mar-17	7-Apr-17
Issuance of LOS	15	7-Apr-17	22-Apr-17
Signing of IA and EPA	60	22-Apr-17	21-Jun-17
Financial Close Activities	120	7-Apr-17	5-Aug-17
Construction Activities	600	5-Aug-17	28-Mar-19
Commercial Operations Date			28-Mar-19

12.3 Project Life

As per the standard energy purchase agreement (“EPA”) the Project life and EPA term has been assumed as 30 years from COD and all equipment is being procured corresponding to the same.

12.4 Project Cost

The break-down of the estimated Project Cost is provided below in Table 17. The Engineering, Procurement & Construction Cost accounts for 80% of the total Project Cost. The project cost is



based on an average PKR/USD exchange rate of PKR 110/USD. It may be noted that only 40% of the devaluation over the construction period is to be adjusted in the final tariff to be determined by NEPRA.

Table 18: Estimated Project Cost

Estimated Project Cost*	USD million	PKR million
EPC Cost	26.00	2,860.00
Non-EPC Cost	0.94	103.17
Project Development Costs	2.30	253.47
Insurance during Construction	0.20	21.45
Financing Fee & Charges	0.91	100.36
Interest during Construction (IDC)	2.19	241.33
Total	32.54	3,579.79
<i>EPC Cost per MW (USD million)</i>	<i>1.00</i>	
<i>Project Cost per MW (USD million)</i>	<i>1.25</i>	

*Project cost is based on preliminary estimates and will be firmed up when EPC contract is finalized

- **EPC Cost** at USD 1.00 per kW has been based on applicable costs in precedent transactions with an adjustment for smaller plant size. The Company is in the process of finalizing the equipment for the Project. The Project may opt for EPC or multiple vendor package and this shall be updated in due course.
- **Non-EPC** costs include costs related to:
 - Non-reimbursable fuel during testing at USD 0.44 million based on an estimated bagasse consumption of 15,000 MT.
 - Other costs estimated at USD 0.50 million
- **Project Development** costs include costs related to technical studies, owners' engineer, construction manager as well as legal and other advisors estimated at USD 1.14 million; fees related to NEPRA, AEDB, SECP as well guarantee costs estimated at USD 0.16 million; and Company overheads during the construction period estimated at USD 1.0 million.
- **Construction Insurance** has been budgeted at 0.75% of EPC cost.
- **Financing Fees & Charges** have been estimated in line with precedent transactions and have been budgeted in the range of 3.5% of total debt.
- **Interest during Construction** has been calculated over a 20-month construction period, an 80:20 debt to equity ratio and a lending rate of 3-month KIBOR plus 3.0%. Disbursement over the 20-month period is based on an advance payment of 15.0%; final acceptance payment of 5% and an equal distribution over the remaining 18 months. The payment profile shall be firmed at the time of finalization of the EPC contract(s).

12.5 Project Financing

The Project financing will be based on a debt to equity ratio of 80:20. Under the base case financial projections debt is assumed to be repaid 10 years after COD with debt being amortized over the period through fixed annuity based installments.

Key parameters of the Project funding are provided in Table 19 below:

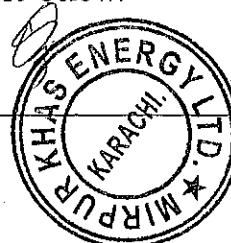


Table 19: Project Funding

Project Cost	PKR 3,579.79 million
Debt	PKR 2,863.83 million
Equity	PKR 715.93 million
Lending Rate	9.44% (3-month KIBOR + 3.0%)
Repayment Period	10 years
Repayment Frequency	Quarterly
Annual Installment	PKR 445.64 million

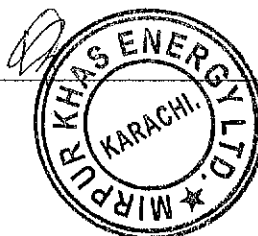
12.6 Project Tariff

NEPRA had announced a 30-year Upfront Tariff for high pressure boiler based bagasse power projects in May 2013 which was valid for a period of 2 years. Subsequently, the Upfront Tariff was extended up to May 2017 and in the meanwhile an adjusted Upfront Tariff (**Adjusted Upfront Tariff**) was announced based on indexations applicable at May 2015. As per discussions with NEPRA, the Adjusted Upfront Tariff shall be applicable for the Project.

The Adjusted Upfront Tariff is calculated on notional capacity of 1.00 MW with appropriate indexing of different tariff determining components. This tariff structure is generic in nature and is applicable for various sizes of new bagasse based co-generation power plants of 60 bar or higher pressure boilers. The critical assumptions upon which the tariff is based appear in the table below:

Table 20: Key Assumptions for Adjusted Upfront Tariff

Description	Basis
Auxiliary Consumption	8.5%
Plant Factor	45%
EPC cost per MW	USD 0.7960
Project Cost per MW	USD 0.9795
Construction Period	20 months
Exchange rate (PKR/USD)	101.60
Benchmark Efficiency	24.5%
Bagasse Price	Linked to CIF Karachi Coal Price, Minimum USD 100.67 per MT
Bagasse CV	6,905 BTU/kg
Total O&M Cost	3.25% of EPC
Variable O&M Local	15% of total O&M
Variable O&M Foreign	45% of total O&M
Fixed O&M Local	40% of total O&M
Insurance	1.0% of EPC
Working Capital	45 days of Fuel @ 3 month KIBOR plus 2.0%
Debt	80%
Return on Equity	17.0%



Return on Equity during Construction	17.0%
Loan Repayment Period	10 years
Repayment Frequency	Quarterly
Debt Cost	3 month KIBOR plus 3.0% (Base KIBOR: 7.99%)

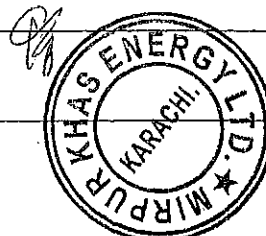
Respective tariff components along with relevant indexations are provided in Table 20 below:

The tariff is payable on a take or pay basis based on the declared availability of the Plant by the Company. Key features of the tariff applicability are as follows:

1. For all energy dispatched to the grid, a tariff based on the sum of indexed values of all the above mentioned components shall be payable.
2. During the crushing period, if the Plant is not dispatched following a declaration of energy a tariff based on the sum of indexed values of all the above mentioned components shall still be payable based on the declared energy.
3. During the non-crushing period, if the Plant is not dispatched following a declaration of energy a tariff based on the sum of indexed values of all the above mentioned components (excluding the fuel and variable components) shall be payable based on the declared energy.
4. All upside and downside risk with respect to the annual generation lies with the Company. In case the Company is able to achieve a plant factor above 45% the full indexed tariff shall be payable.

Table 21: Adjusted Upfront Tariff

Description	Reference Tariff PKR per kWh		Indexation
	Year 1-10	Year 11-30	
Fuel Cost	5.9825	5.9825	Yearly PKR/USD parity and annual CIF Coal Price w.e.f 1st October of each year
Variable O&M – Local	0.1198	0.1198	Quarterly CPI changes notified by FBS on start of each quarter
Variable O&M – Foreign	0.3393	0.3393	Quarterly changes in PKR/USD and US CPI changes notified by Bureau of Labor Statistics on start of each quarter
Fixed O&M	0.3194	0.3194	Quarterly CPI changes notified by Federal Bureau of Statistics (“FBS”) on start of each quarter
Insurance	0.2204	0.2204	No indexation
Working Capital	0.1673	0.1673	Quarterly adjustment for changes 3 M KIBOR
Return on Equity	1.0345	1.0345	After onetime adjustment at COD, annual changes in PKR/USD parity
Debt Servicing Component	3.6658		After onetime adjustment at COD, quarterly changes in 3-M KIBOR
Total Tariff	11.8491	8.1833	
Levelized Tariff	10.5727		



Note: The tariff is adjusted quarterly for changes in 3-month KIBOR variations. The financial projections have been prepared on the basis of the recent 3-month KIBOR rate of 6.44% with the tariff and related cost adjusted accordingly.

12.7 Project Revenue

As stated above, the Project shall be selling power to the national grid as well as partially meeting the power and steam requirements of MSML. In such a case, the Project shall be expecting three (3) revenue streams as follows:

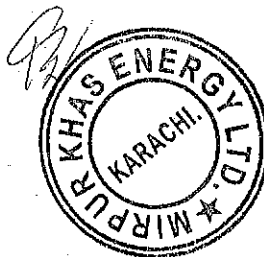
- Sale of energy to national grid i.e. CPPA-G
- Sale of energy to MSML
- Sale of steam to MSML

12.8 General

The base case financial projections show that the Project is expected to generate a positive earnings before interest, taxes and depreciation (EBITDA) and net profits throughout the life of the Project.

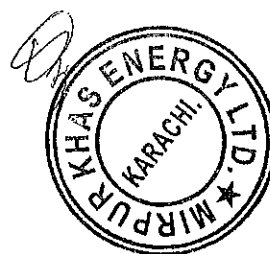
12.9 Projected Financial Statements

Projected financial statements and key financial ratios based on the base case assumptions discussed in Section 13 are provided in the following sections. Financial Statements presented below are limited to the 10-year debt period.



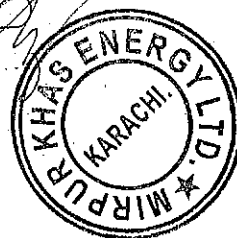
12.10 Projected Income Statement

PKR million	1	2	3	4	5	6	7	8	9	10
REVENUE										
Power to Sugar Mill	129	129	129	129	129	129	129	129	129	129
Power to CPPA-G	1,127	1,127	1,127	1,127	1,127	1,127	1,127	1,127	1,127	1,127
Steam for Sugar Mill	82	82	82	82	82	82	82	82	82	82
Total Revenue	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338
Bagasse Cost	647	647	647	647	647	647	647	647	647	647
Local Variable O&M	14	14	14	14	14	14	14	14	14	14
Foreign Variable O&M	47	47	47	47	47	47	47	47	47	47
Local Fixed O&M Cost	38	38	38	38	38	38	38	38	38	38
Total O&M Cost	99	99	99	99	99	99	99	99	99	99
Insurance Cost	21	21	21	21	21	21	21	21	21	21
Depreciation	119	119	119	119	119	119	119	119	119	119
EBIT	451	451	451	451	451	451	451	451	451	451
Working Capital Cost	21	21	21	21	21	21	21	21	21	21
Interest on LT Loan	264	246	227	205	182	156	128	97	63	25
Net Income	166	184	203	225	248	274	302	333	367	405



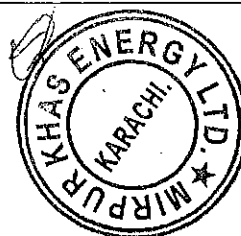
12.11 Projected Balance Sheet

PKR millions	1	2	3	4	5	6	7	8	9	10
Fixed Assets	3,460	3,341	3,222	3,102	2,983	2,864	2,745	2,625	2,506	2,387
Advance	-	-	-	-	-	-	-	-	-	-
Accounts Receivable	-	-	-	-	-	-	-	-	-	-
Debt Reserves	-	-	-	-	-	-	-	-	-	-
Cash	-	-	-	-	-	-	-	-	-	-
Total Current Assets	-	-	-	-	-	-	-	-	-	-
Total Assets	3,460	3,341	3,222	3,102	2,983	2,864	2,745	2,625	2,506	2,387
Accounts Payable	-	-	-	-	-	-	-	-	-	-
Working Capital	-	-	-	-	-	-	-	-	-	-
Debt Current Portion	199	219	240	264	290	318	349	383	421	-
Current Liabilities	199	219	240	264	290	318	349	383	421	-
Long-term Debt	2,483	2,264	2,024	1,760	1,470	1,153	804	421	-	-
Total Liabilities	2,682	2,483	2,264	2,024	1,760	1,470	1,153	804	421	-
Paid-up Capital	716	716	716	716	716	716	716	716	716	716
Retained Earnings	62	142	242	363	507	677	876	1,106	1,369	1,671
Total Equity	778	858	958	1,079	1,223	1,393	1,592	1,822	2,085	2,387
Equity & Liabilities	3,460	3,341	3,222	3,102	2,983	2,864	2,745	2,625	2,506	2,387



12.12 Projected Cash Flows

PKR millions	1	2	3	4	5	6	7	8	9	10
Earnings after tax	166	184	203	225	248	274	302	333	367	405
Add: Depreciation	119	119	119	119	119	119	119	119	119	119
Change in Advances	-	-	-	-	-	-	-	-	-	-
Change in A/C Receivable	-	-	-	-	-	-	-	-	-	-
Change in A/C Payable	-	-	-	-	-	-	-	-	-	-
Cash Flow from Operations	285	303	322	344	367	393	421	453	487	524
Cash Flow from Investment	-	-	-	-	-	-	-	-	-	-
Repayment of LT Debt	(182)	(199)	(219)	(240)	(264)	(290)	(318)	(349)	(383)	(421)
Repayment of WC Loan	-	-	-	-	-	-	-	-	-	-
Disbursement of Equity	-	-	-	-	-	-	-	-	-	-
Cash Flow from Financing	(182)	(199)	(219)	(240)	(264)	(290)	(318)	(349)	(383)	(421)
Net Cash Flow	104	104	104	104	104	104	104	104	104	104

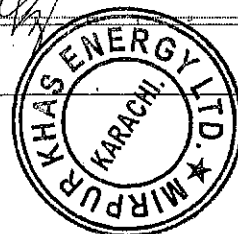
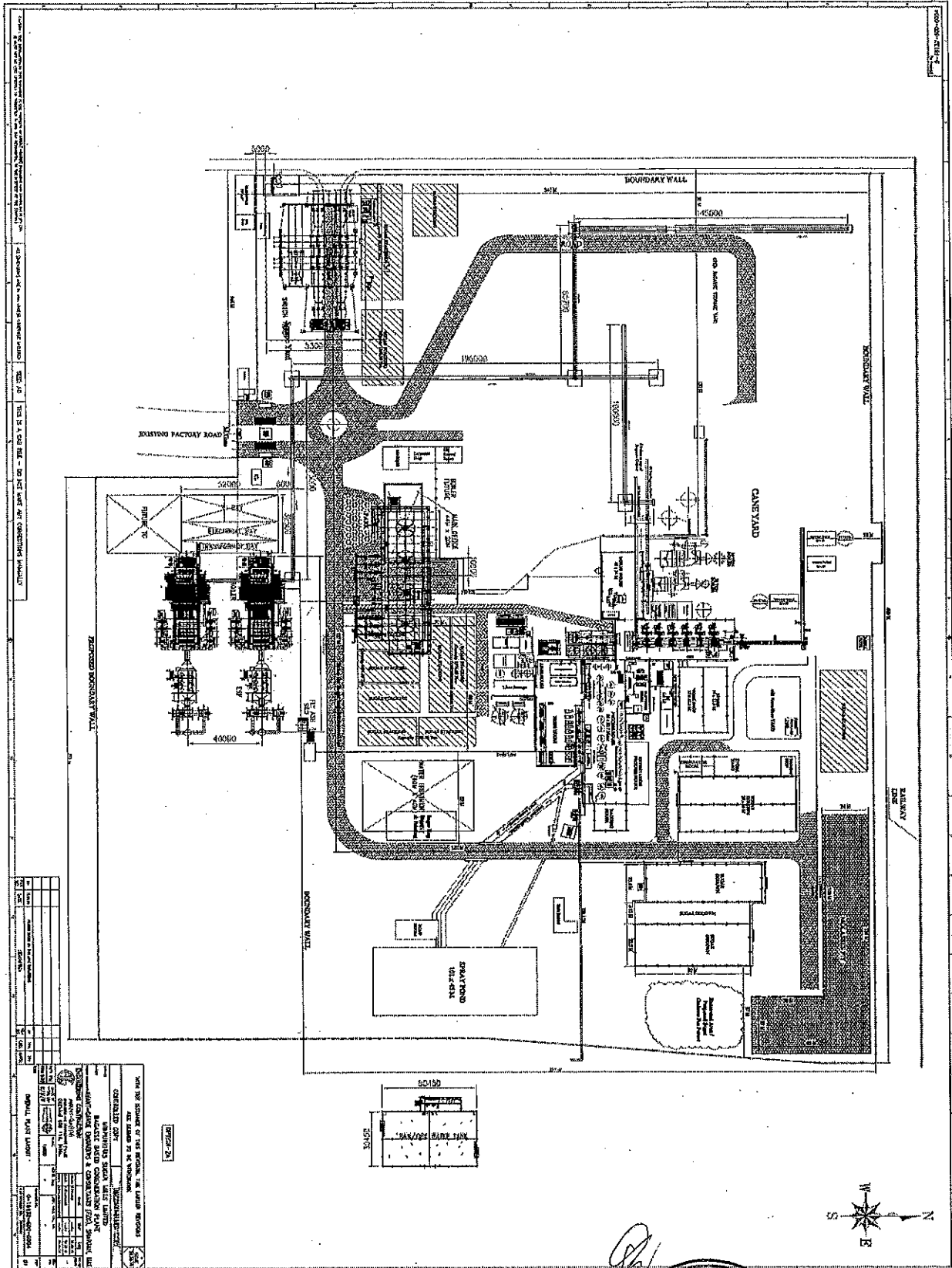


13 Financial Summary

	Min.	1	2	3	4	5	6	7	8	9	10
Revenue	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338	1,338
EBITDA	570	570	570	570	570	570	570	570	570	570	570
Net Income	166	166	184	203	225	248	274	302	333	367	405
Dividends	104	104	104	104	104	104	104	104	104	104	104
Annual Interest	46	285	267	248	227	203	177	149	118	84	46
Debt Servicing	446	446	446	446	446	446	446	446	446	446	446
Debt to Equity	-	3.45	2.89	2.36	1.88	1.44	1.06	0.72	0.44	0.20	-
Times Interest	2.00	2.00	2.13	2.30	2.52	2.81	3.22	3.83	4.84	6.81	12.32
DSCR	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28
Loan Life Cover Ratio	1.24	1.25	1.25	1.25	1.24	1.24	1.24	1.24	1.24	1.24	1.24



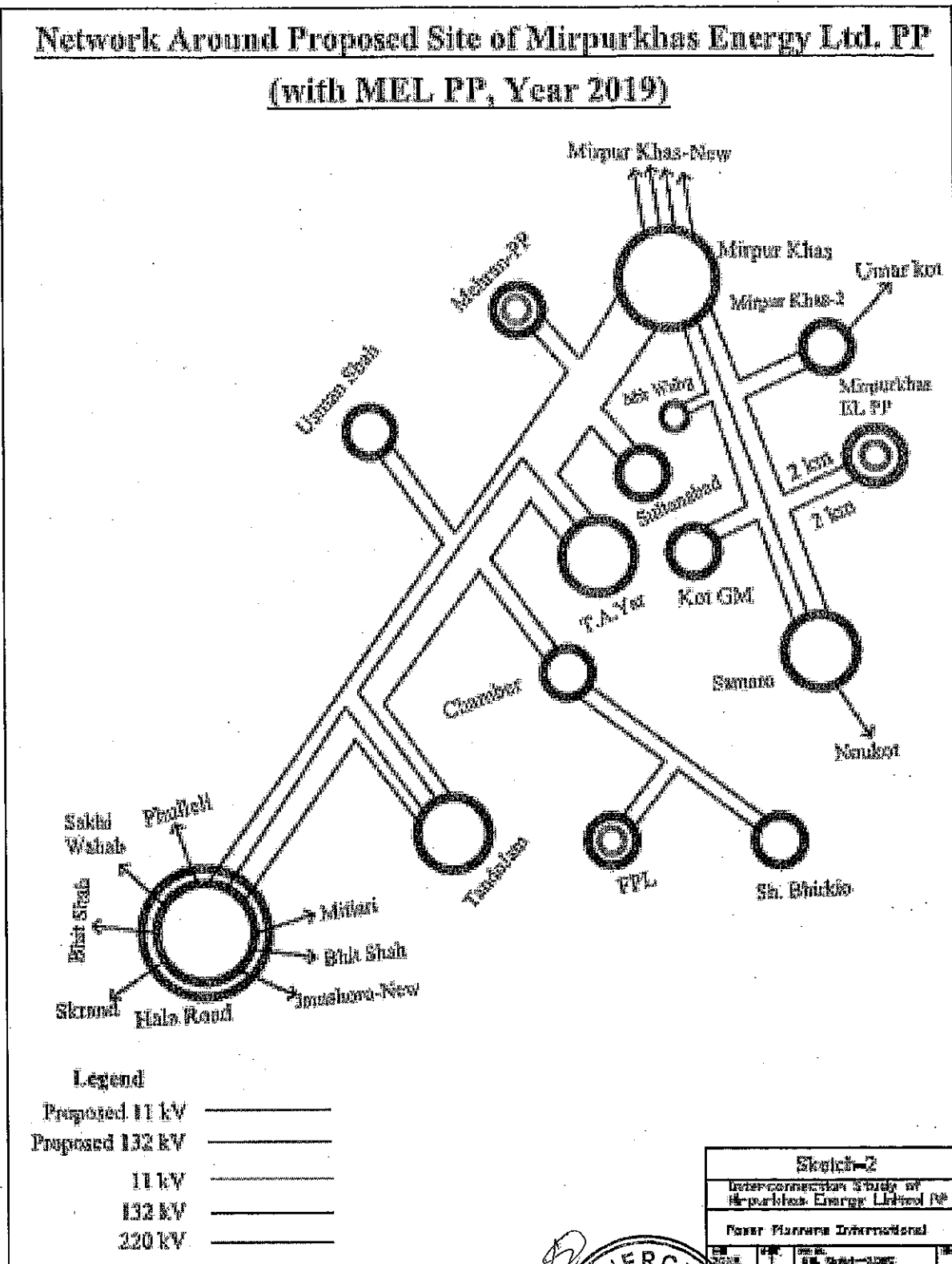
14 Annexure-1: Plant Layout



Network Around Proposed Site of Mirpurkhas Energy Ltd. PP
(without MEL PP, Year 2019)



Network Around Proposed Site of Mirpurkhas Energy Ltd. PP
(with MEL PP, Year 2019)



Prospectus

Introduction of Applicant

Mirpurkhas Sugar Mills Limited ("MSML") through a wholly-owned subsidiary Mirpurkhas Energy Limited ("MEL") intends to set up a green field 26 MW (Gross) high-pressure bagasse based co-generation power plant ("Project") under the provisions of the Framework for Power Cogeneration 2013 ("Framework") and Policy for Development of Renewable Energy for Power Generation 2006 ("RE Policy" or "Policy"). The Project will be located adjacent to MSML located at Jamrao, Umerkot Road, Mirpurkhas, Sindh, Pakistan.

The Project will sell power to the national grid through sale of energy to the Central Power Purchasing Agency Guarantee Limited ("CPPA-G") under a 30-year Energy Purchase Agreement ("EPA") as well partially meet the steam and power requirements of MSML during the crushing season. The Project will enable MSML to establish a sustainable market for its by-product, bagasse, and will also allow the sponsors of MSML to take an exposure in the power sector through incentives offered by the Government of Pakistan ("GoP") under the Framework and RE Policy.

Salient features of the facility for which license is sought

The broad parameters of the project are as under:

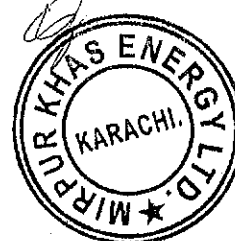
Project Capacity	26.00 MW (Gross)
Project Location	Jamrao, Umerkot Road, Mirpurkhas, Sindh
Land Area	20 Acre
Construction Period	20 months
Technology	Bagasse/Bio-Mass.
Power Purchaser	Central Power Purchasing Agency Guarantee Limited
Steam Turbines	1 X 26.00 M.W extraction cum condensing
Boilers	1 X 130 TPH, 110 Bar 540°C
Upfront Levelized Tariff	US Cents 10.62 per kWh

Proposed Investment

The total cost for the project is approximated PKR 3,579.79 Million, which is expected to be financed in a debt to equity ratio of 80:20.

Social and Environmental Impact of the Proposed Facility

Bagasse based Cogeneration power plant, offers a number of advantages both to the sugar industry and to the country. Besides reducing gap between the demand and the supply in the power sector, Bagasse based fuel power cogeneration provides environmentally friendly solution for additional power generation, reduces dependence on fossil fuels, saves on hard earned foreign exchange from its outflow from the country for import of fossil fuels and gives sugar industry financial gains in the form of cheaper energy while using Bagasse as fuel.



Schedule III

General Information

(i)	Applicant's Name	Mirpurkhas Energy Limited
(ii)	Registered Office	Sub Post Office Sugar Mills Jamrao, Umerkot Road, Mirpurkhas
(iii)	Plant Location	Sub Post Office Sugar Mills Jamrao, Umerkot Road, Mirpurkhas
(iv)	Type of Generation Facility	Bagasse fired Cogeneration Power Plant
(v)	Commissioning/Commercial Operation Date	March 2019
(vi)	Expected Life of the Facility from Commercial Operation/Commissioning	30 years
(vii)	Expected Remaining Useful Life of the Facility	30 years

1. Location maps, site maps and land

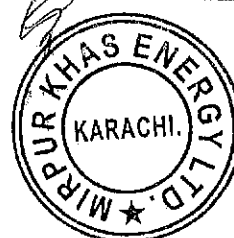
- Location map attached as Annex-1A
- Site map (Land Detail) attached as Annex-1B
- Water source map attached as Annex-1C
- Plant Layout attached as Annex-1D
- The Project Site is adjacent to Mirpurkhas Sugar Mills Limited ("MSML") located at Jamrao, Umerkot Road, Mirpurkhas, Sindh. The adjacent area is owned by MSML and approximately 20 acres will be allocated to Mirpurkhas Energy Limited under a lease agreement for a period of 30 years plus construction period.

2. Technology, Size of Plant and Number of Units

(i)	Type of Technology	Cogeneration Power Plant with high pressure boilers and Turbo-Generators
(ii)	Installed Plant Capacity (Gross)	26.00 MW (Gross)
(iii)	Number of Units	One (01)
(iv)	Unit make, model & year of manufacture	SIEMENS, Model 2017
(vi)	Available Capacity	Power Generation: 25.50 MW (Season operation) 26.00 MW (Off-season operation)
(v)	Auxiliary Consumption	Approximately 9.0 %

3. Fuel: Type, Imported/Indigenous, Supplier, Logistics

(i)	Primary Fuel	Bagasse
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(ii)	Alternate Fuel	NIL
(iii)	Fuel Source (Imported/Indigenous)	Indigenous
(iv)	Fuel Supplier	Mirpurkhas Sugar Mills Limited
(v)	Supply Arrangement	Through conveyor belts/loading trucks/tractor trolleys etc.,
(vi)	Sugarcane Crushing Capacity	354.17 TPH
(vii)	Bagasse Generation Capacity	109.10 TPH
(viii)	Bagasse Storage Capacity	Bulk Storage
(ix)	Number of Storage Tanks	Not Applicable, bagasse shall be stored in open yard

4. Emission Values

		Primary Fuel	Start-up Fuel
(i)	SO _x (mg/Nm ³) as SO ₂	<1700	
(ii)	NO _x (mg/Nm ³)	<400	<600
(iii)	CO ₂	12-16	
(iv)	CO (mg/Nm ³)	<800	
(v)	PM ₁₀ (mg/Nm ³)	<500	<300

5. Cooling Water Source

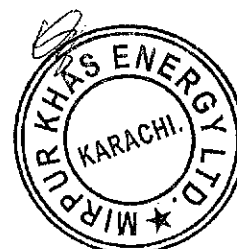
(i)	Cooling Water Source/Cycle	Canal water from Jamrao Canal East Branch + R.O(Treated water)
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6. Interconnection

(i)	Name of Nearest Grid	Mirpurkhas-2
(ii)	Distance of Grid from Project Site	3 km
(iii)	Voltage Level	132 kV
(iv)	Single Line Diagram	Attached as Annex-2

7. Infrastructure

(i)	Road	MEL is located at a distance of 8 KM away from Mirpurkhas on Umerkot road. It has an approach from Mirpurkhas Umerkot Road and is also connected with old Mirpurkhas Road which is further connected to Mirpurkhas Sanghar Road
(ii)	Rail	Mirpurkhas Khohkhrapar railway track is passing along the boundary wall. Nearest stations are Veesro at 0.5 km away from the Plant and Mirpurkhas station is 5 Km from the Plant which is connected to the national railway network.
(iii)	Staff Colony	MSML has a large staff colony over an area of 60 acres which includes guest houses, bungalows, quarters and hostels for the staff. Colony has all basic amenities available. The staff colony maybe utilized by staff of MEL.



(iv)	Amenities	<p>Dispensary: A well-equipped dispensary is available to meet any emergency to workers and staff.</p> <p>Ambulance: An ambulance with ready staff is also available for 24 hours.</p> <p>School: School for children of colony and surrounding area is also available.</p> <p>Fair price Shop: Fair price shop for staff and colony is also available.</p> <p>Water filter plant: Water filter plant is also available to provide clean water to houses and plant.</p> <p>Pick and Drop Service: Buses and vans are available for staff to provide pick and drop services from Mirpurkhas city.</p>
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8. Project Cost and Financing

Estimated Project Cost*	PKR million
EPC Cost	2,860.00
Non-EPC Cost	103.17
Project Development Costs	253.47
Insurance during Construction	21.45
Financing Fee & Charges	100.36
Interest during Construction (IDC)	241.33
Total	3,579.79
Debt	2,863.83
Equity	715.93

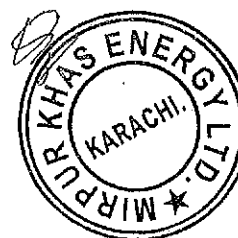
*Estimated projected cost is based on an average PKR/USD exchange rate of 110.

9. Project Commencement and Completion Schedule

Activity	Duration	Start Date	End Date
Issuance of LOI			8-Nov-16
EPC Activities	120	8-Nov-16	8-Mar-17
Grid Study, Approvals & CPPA-G Consent	120	8-Nov-16	8-Mar-17
Generation License Application & Approval from NEPRA	60	16-Jan-17	17-Mar-17
Tariff Application and Approval from NEPRA	30	8-Mar-17	7-Apr-17
Issuance of LOS	15	7-Apr-17	22-Apr-17
Signing of IA and EPA	60	22-Apr-17	21-Jun-17
Financial Close Activities	120	7-Apr-17	5-Aug-17
Construction Activities	600	5-Aug-17	28-Mar-19
Commercial Operations Date			28-Mar-19

10. Environment and Social Soundness Assessment

Report attached as Annex-3



11. Safety and Emergency Plans

HSE Plan attached as Annex-4

12. System Studies, Load flow, Short circuit etc.

Detailed Interconnection and Grid Study has been submitted to HESCO for approval, attached as Annex-5.

13. Plant Characteristics

(i)	Generation Voltage	11 kV	
(ii)	Frequency	50 Hz	
(iii)	Power Factor	0.8 (lag)	
(iv)	Automatic Generation Control (AFG)	Yes	
(v)	Ramping Rate	3.2 kW/sec	
(vi)	Time Required to Synchronize to Grid and Loading the Complex to Full Load from Cold Start	During cold start (i.e. when plant is started later than 72 hours after shutdown)	240 minutes
		During warm start (i.e. when plant is started at less than 36 hours after shutdown)	90 minutes
		During Hot start (i.e. when plant is started at less than 12 hours after shutdown)	60 minutes

14. Control, Metering, Instrumentation and Protection

Attached as Annex-6.

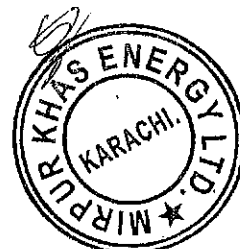
15. Training and Development

The training and development program has been given due recognition so that safe and reliable operation and maintenance of the plant can be ensured. Training and Development programs have been devised to properly use various tools for training.

Apprenticeship Programs: One graduate and one skilled person will be absorbed in the plant for a period of one and half years in each of operation, electrical, instrumental and control, and mechanical department. He will be attached with assistant executive engineer level person. For skilled apprentice, the attachment will be with Foreman level person. Through such program the Plant will be serving the community as well as a database for company referral, when needed.

Training at Plant: Section wise training at plant on quarterly basis. The training to be imparted by senior plant management as well as by industry expert. The training to be imparted on two-tier basis; for lower management and middle management.

Training and Development abroad: The top tier to undertake management training and refresher on a six-monthly basis and to undergo foreign career development training every three months.



Operation and Maintenance Manuals: Referral to these manuals is a very good self-training and development tool. They are made by the experts of equipment and systems and are focused towards safe operation and corrective maintenance. They are very useful when consulted before and after the undertaking the work.

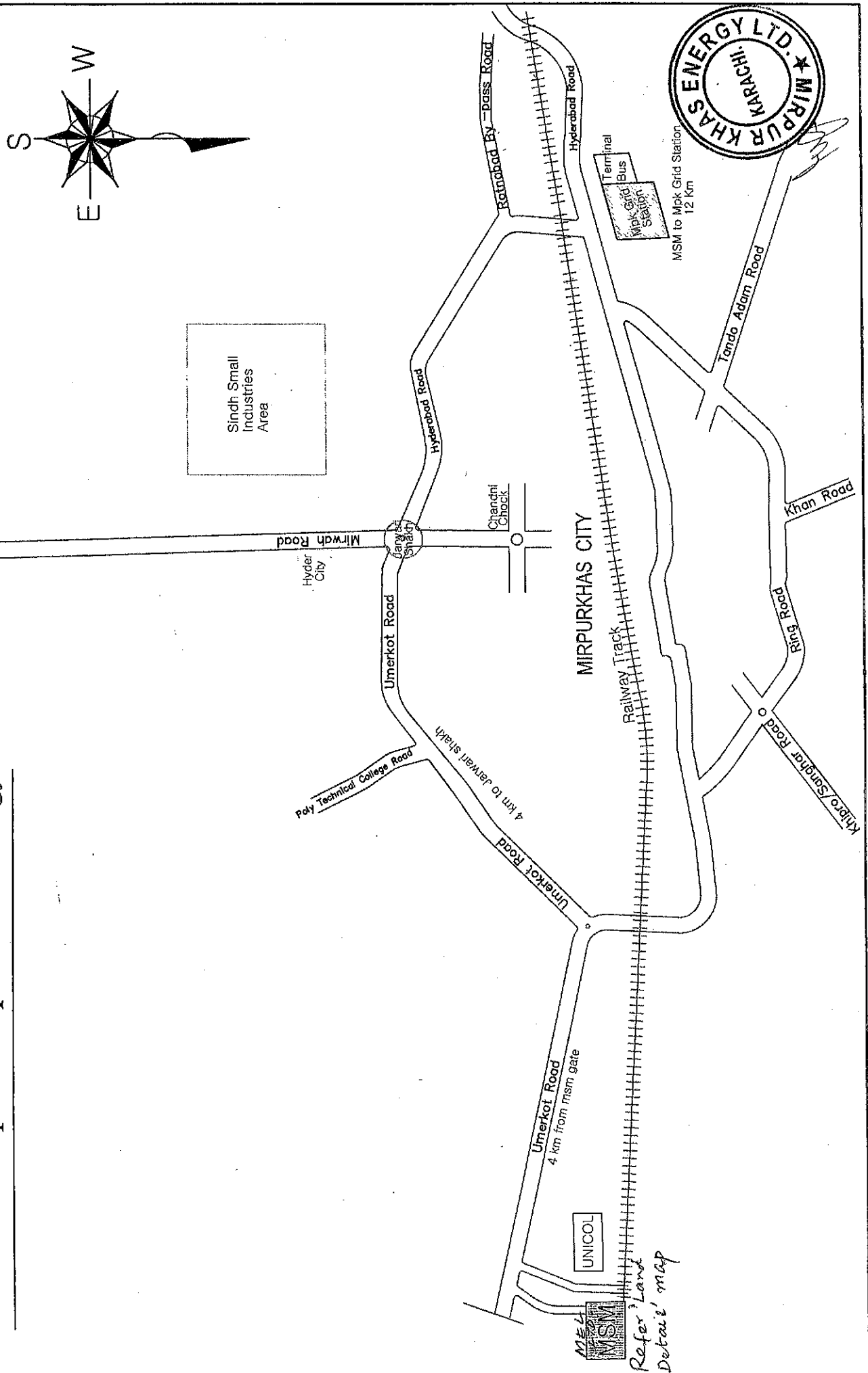
Visits and Trainings at Manufacturers' Works: Visits and trainings at outsourced maintenance firms is often a very good training source.

Working together with EPC Contractor: Each plant has certain unique features therefore the EPC contractor is often in the best position to operate and maintain. Entering into O&M agreement for an initial period of one or two years following project completion is a rich source of training and development of plant personnel.

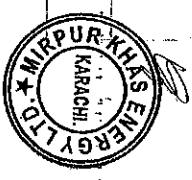
Training and Development is an ongoing activity and the project Sponsors will devise the programs such that the benefits of various types of training are best attained.

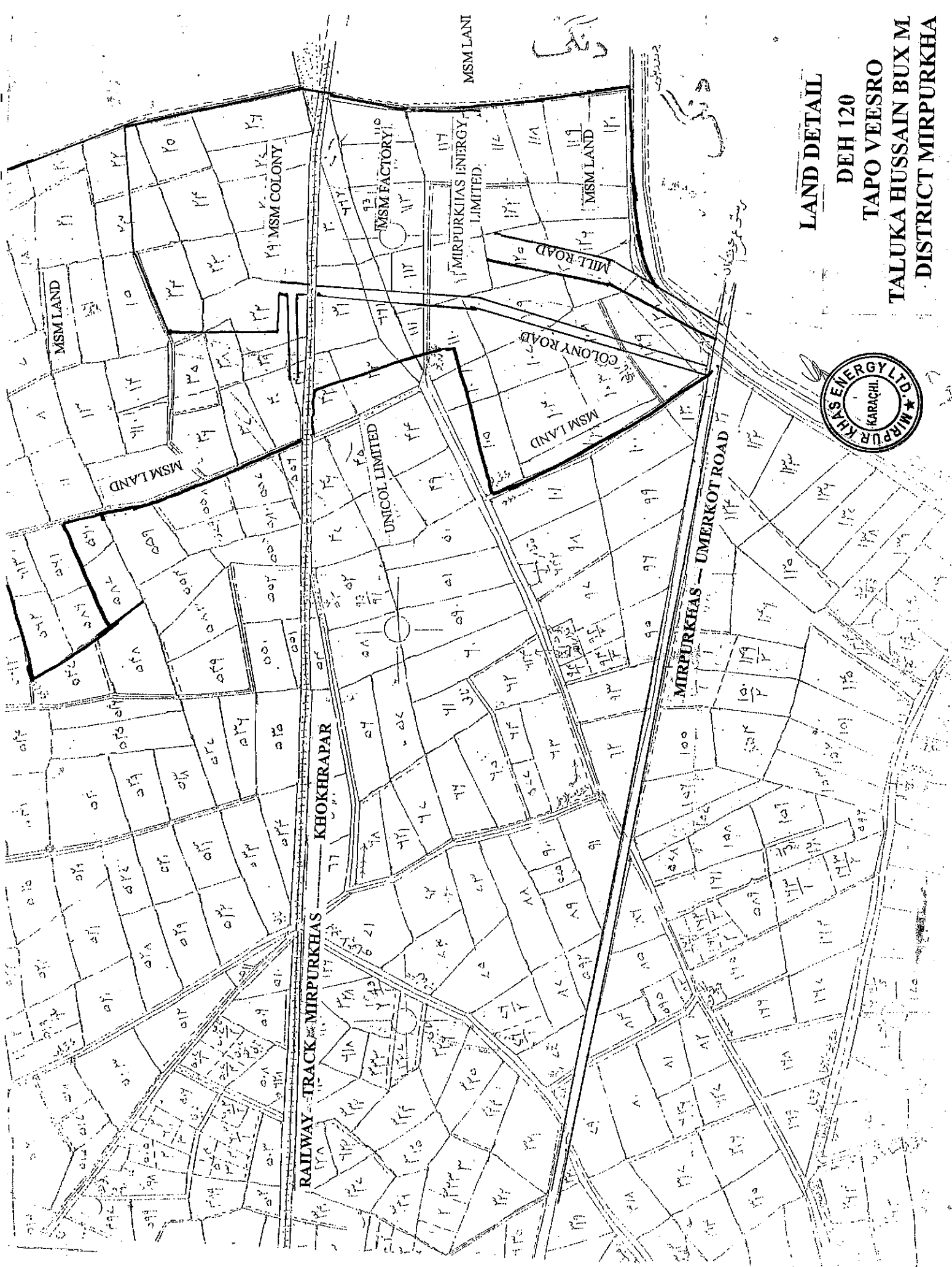


Location Map of Mirpurkhas Energy



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MSM LAND

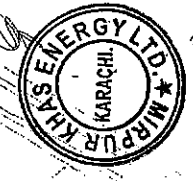
LAND DETAIL

DEH 120

TAPO VEESRO

TALUKA HUSSAIN BUX M

DISTRICT MIRPURKHA



Sukkar Barraje

Khairpur

WATER SOURCE OF MIRPURKHAS ENERGY

Nara Canal
Length 175 km

Nara Canal from Sukkar Barraje to Jamrao Head	175 Km
Main jamrao Canal =	90 Km
East Branch Jamrao Canal up to mpk energy outlet	35 Km
Outlet to Mirpurkhas sugar & energy	3 Km
Total = 303 Km	

Jamrao Head

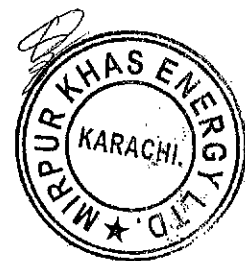
Sanghar

Main Jamrao Canal
Length 90 km

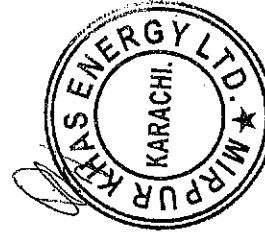
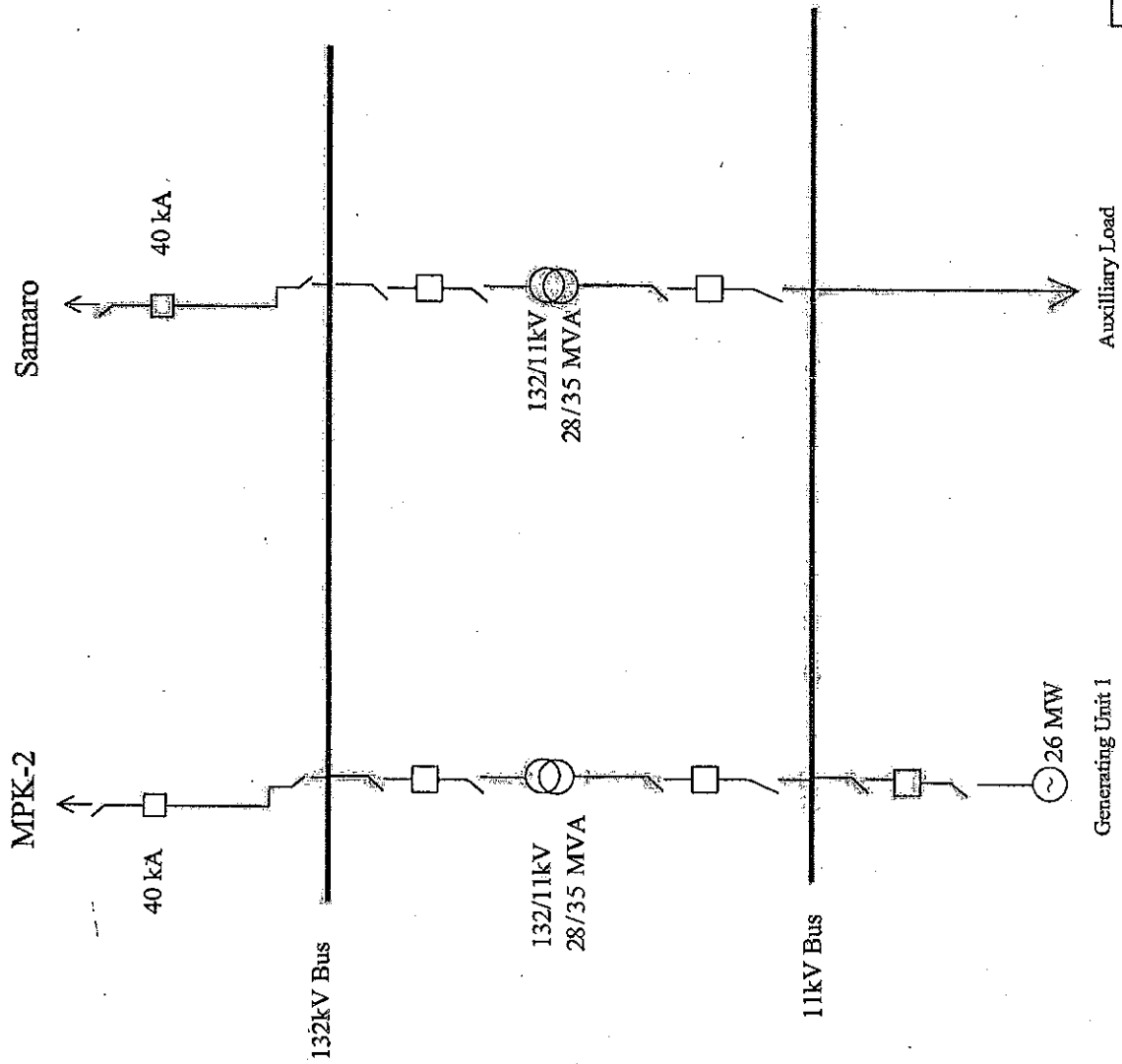
Nauabad

Jamrao East Brach
Length up to Mpk Enery 35 km

Mirpurkhas



Single Line Diagram of 132/11 kV Busbar At MEL-PP



SLD-1

Thermal Power Plant by Mirpur Khas Energy Ltd.

Power Planners International

DATE	2017	NO.	1	REV.	SLD.DWG
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Chapter

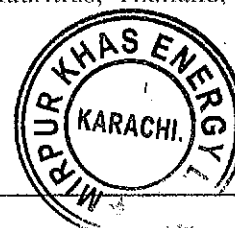
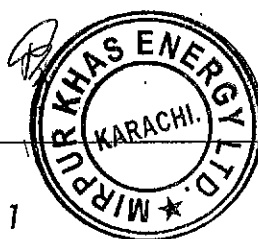
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INTRODUCTION

1.1 PREAMBLE

Cogeneration, the concept of utilizing the same fuel resource for meeting with the requirements of both thermal and electrical energy, is gaining wide acceptance and encouragement world over. Cogeneration is widely practiced in the process Industries and any process industry which employs low pressure steam for the process has the potential to become a virtual power house. With increasing concern on global warming, the use of renewable energy, which has the positive effect of not adding to the global warming, is being looked at with renewed interest. The Cogeneration cycle with its higher cycle efficiency, compared to the power cycles, ensures that the scarce natural resources are put to better use.

Currently Pakistan has an installed electric generation capacity of about 20,000 MW, with the demand far exceeding this installed capacity and the access to electricity in Pakistan is about 62%. With a fast-growing economy and demography, the projection for the demand in 2030 is forecast to be 100,000 MW. This calls for a tremendous growth rate in the power sector. The Government of Pakistan is making all out efforts to increase the generation capacity by tapping all conventional and non-conventional sources of electricity generation. Born out of this Government's initiative to augment the generation through non-conventional energy sources is the "National Policy for Power Cogeneration by Sugar Industry" promulgated in January 2008. The Government of Pakistan has recognized that Bagasse based Cogeneration can play a significant role in the country's efforts to augment the electricity generation. Power generation is a separate business regulated by National Electric Power Regulatory Authority (NEPRA). The licensee generating power from bagasse of adjoining, nearby sugar mill can export power to the grid, buying bagasse from mill and selling steam and power needed by sugar mill through separate agreements. The Policy of Government of Pakistan, however, requires that the licensee puts up new power plant with high pressure boiler to sell power to nearby grid operated by either a DISCO (Distribution Company) or for National Transmission Distribution Company (NTDC). . Cogeneration plants with high pressure boilers and matching turbo generators, exporting power to grid, have been installed in sugar industries in India, Mauritius, Thailand, Re-Union Islands, United States, etc.



With the advantages like no transportation of fuel, reduction in transmission losses, eco-friendly power generation, etc. sugar plants could perform as supplementary power generating companies and make any country move towards self-reliance in power sector. Sugar Industry in Pakistan is ranked as country's second largest agro based industry after textiles. Presently there are about 87 sugar mills in Pakistan producing about 5.5 million Metric Tons of sugar per annum and approx. total crushing capacity 700000 TCD, which can produce approximately 3000 MW during crop season.

Cane Availability, Present & Future:

Pakistan occupies an important position in cane producing countries of the world. It ranks at the fifth position in cane acreage and production and is in top 20 countries in sugar production.

In order to increase the production of sugar cane several steps were taken by the Govt. and the sugar mill association to help formers. In past several reports/research work to increase the production were published on different process which include chemical composition as well as agricultural reforms/steps to increase the recovery and %age yield

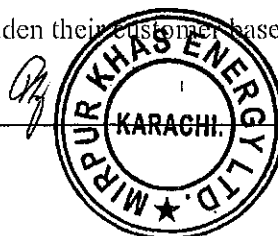
Sugarcane has been the major cash crop grown in the Province due to conducive environmental conditions for sugarcane growing, good quality of soil for cultivation and adequate irrigation facilities. New varieties are developed along with modern cultivation and irrigation practices. This has led to increased crop yield & sugar recovery, as compared to the other provinces. Sugar factories are expected to have excess cane availability during coming years, even after fulfilling their own crushing requirements. As of now, there is no alternative arrangement available to crush this excess cane. This would extend the crushing period

Table: Sugarcane in Pakistan

Provinces	Sugarcane area (000ha)			Sugarcane production (M.T.)			Sugarcane yield			Sugar recovery (%)
	2012-13	2013-14	Change %	2012-13	2013-14	Change %	2012-13	2013-14	Change %	
Punjab	767.7	756.75	-1.42	42.98	43.7	1.67	56.0	57.75	3.12	9.92
Sindh	253.7	297.6	17.30	15.96	17.37	8.80	62.9	58.4	-7.2	10.49
KPK	106.7	107.7	0.9	4.77	4.82	1.1	44.7	44.8	0.2	9.23
Baluchistan	0.7	0.7	0.7	0.31	0.32	2.2	45.0	46.0	2.2	--

Identification of Project & Project Proponent

The Ghulam Faruque Group ranks amongst the most prominent commercial and industrial business houses in Pakistan. The Group is recognized for its entrepreneurial skills and valuable contribution to the economy of the Country, since its inception in 1964. The group intends to look for innovative ways to introduce alternate uses of sugar byproducts to broaden their customer base.



M/s. Mirpurkhas Energy Limited (MEL) has been established under the umbrella of Ghulam Faruque Group in the province of proposed to be set up adjacent to Mirpurkhas Sugar Mill (MSML) of 8500 TCD capacity, located at Jamrao, Umerkot Road, Taluka Hussain Bux Mari, District Mirpurkhas, Sindh, Pakistan

Nature and Size of the Project

Nature:

M/s. Mirpurkhas Energy Limited (MEL) , Mirpurkhas Sindh, a 100% owned subsidiary of Mirpurkhas Sugar Mill, intend to set up a cogeneration power plant at Jamrao, Umerkot Road, Taluka Hussain Bux Mari, District Mirpurkhas, Sindh, Pakistan. The project is proposed to be set up adjacent to Mirpurkhasa sugar mill (MSML) of 8500 TCD capacity, located at Jamrao, Umerkot Road, Taluka Hussain Bux Mari, District Mirpurkhas, Sindh, Pakistan. Since power generation is a separate business regulated by National Electric Power Regulatory Authority (NEPRA), the MEL will undertake the power generation and sale in line with approved cogeneration policy in vogue. MEL and MSML will enter into agreements with each other; MEL will buy bagasse from mill; and sell the needed steam and power to MSML. Concurrently the 26 MW Gross MEL power plant with bagasse based new power plant with high pressure boiler will sell power to the grid per terms of sale with HESCO.

MEL Plant Capacity:

The MEL cogeneration power project will generate 26 MW Gross power. It will mainly operate on bagasse bought from MSML. It is expected to generate power during 115 season days of the sugar mill and on saved bagasse for another 75 days during off-season. At designed levels, it will export 23.29 MW at the maximum through national grid for sale to HESCO.

Project Location

The proposed project located at Deh 120 Jamrao, Umerkot Road, Taluka Hussain Bux Mari, District Mirpurkhas, Sindh, Pakistan. Site is just 10 km far away from Mirpurkhas. The site is approachable by Umerkot Road. The purposed site is situated at 25.57° North latitude, 69.03° East longitude and 14 meters elevation above the sea level.

Scope of the Study

To get the Environmental Clearance from the Sindh Environmental Protection Agency it is required to carry out Initial Environment Examination (IEE) for the proposed cogeneration power plant, deliberating the positive and negative impacts on the environment and the surrounding environment

management and monitoring plan (EM&MP) is prepared to mitigate or minimize the negative impact vis-à-vis retaining the positive impacts of the project.

Environment Management Plan has been prepared based on Sindh Environmental Protection Act 2014. For these studies, Environmental Total Solutions has been engaged.

Purpose

The purpose of any EIA/IEE exercise is to identify and assess the adverse impacts of a project in the planning stage itself, so that necessary mitigation measures to prevent or minimize these adverse impacts can be planned early and cost-effectively. In view of this, the specific objectives of this report are:

1. To have an in-depth know-how of the project and to identify the probable sources of pollution that may arise from each stage of the process.
2. To review the current environmental status of the area within 10Km radius of the proposed project site - collection of baseline data on the environmental attributes including air, noise, water, land, ecological, hydro-geological climate and socioeconomic environments.
3. To assessment of likely or potential environmental impacts of the proposed activity (like air, water and soil pollution, noise, waste generation) and the alternatives, including the direct or indirect, cumulative, short-term and long-term effects.
4. To estimate the impacts of the proposed project on the surrounding environment.
5. To prepare a comprehensive Environmental Management Plan to ensure that the Environmental quality of the area would be preserved.
6. To formulate a strategy for effective monitoring and identify any deviations in the environmental quality after the project is operational, which would help in evolving measures to counter these.
7. This IEE has been undertaken pursuant to the Pakistan Environmental Protection Act 1997, the Sindh Environmental Protection Act 2014

Scope of Initial Environment Examination (IEE)

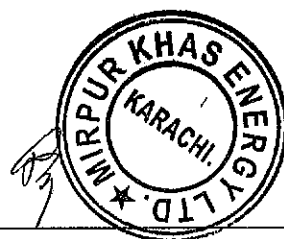
The study envisages characterization of the existing status of physical environment such as air, water, soil, land use, meteorology, socio-economic and heritage etc. as well as biological environment such as flora and fauna of the study area of 10 km radius and quantifying impacts on the environmental parameters. Based on the baseline data, IEE evaluates the proposed control measures by the project and prepares an environment management plan, outlining additional proposed activities and delineates the requirements of environmental monitoring program. IEE-EMP report covers the following aspects:

- Evaluation of present environmental factors through analysis of generated and collected baseline data
- Assess the probable impact on the environmental factors due to implementation of the project with respect to existing scenario.
- Analyze the predicted impact with respect to the regulatory environmental standards.
- Assess the probable risk at the proposed plant.
- Develop an Environmental Management Plan and for the proposed project to mitigate the negative significant impacts that would arise from the proposed project:
 - The baseline data has been collected for the following environmental components
 - Air Quality
 - Meteorology
 - Noise Environment
 - Water Use & Quality
 - Soil Quality
 - Demographic & socio-economic aspects
 - Ecology Biodiversity

Baseline data on parameters of the above-mentioned aspects over a season provides means for identifying possible impact-positive as well as adverse. An environmental impact assessment and environment management plan comprising an overall assessment of the impact due to project activity over baseline condition of the existing environment and a mitigating action plan to counter the adverse impact as defined. An environmental monitoring program is also prepared to provide scientific support to future actions of environmental protection.

Methodology for Initial Environment Examination

The environmental assessment (examination and evaluation is primarily base on simple comparative evaluation approach. Initially the baseline or the profile of the project area is developed by surveys, collecting data, records and information's on physical, ecological/ biological as well as socioeconomic environment. The data so compiled is then projected or modeled for different phases of project, i.e. design, construction, and operation. The likely changes in the critical environment aspects or significant changes in the ambient environmental parameters are identified, assessment and evaluation of significant impacts either in qualitative or quantitative terms is carried out for which appropriate mitigation measures are proposed



Technical Details

Total unit exported will be 19.22 MW/Hr during 115 days cane crushing season and 23.29 MW/Hr will be exported for 75 days in off season. Fuel will be Bagasse

Organization of Report

The report has been divided into following eleven chapters:

Chapter 1: Introduction

This chapter provides the purpose of the report, background information of the proposed project, brief description of nature, size and location of project, objectives of the project, estimated project cost, scope and organization of the study. The key environmental legislation and the standards relevant to the project and the methodology adopted in preparation of this report have also been described in this chapter.

Chapter 2: Project Description

The chapter deals with the need of the project, location, environmental setting of the project, details of project, other technical and design details and sources of Pollution from the proposed activity and measures proposed to control pollution.

Chapter 3: Description of the Environment

The chapter presents the methodology and findings of field studies undertaken to establish the environmental baseline conditions, which is also supplemented by secondary published literature.

Chapter 4: Anticipated Environmental Impacts & Mitigation Measures

The chapter details the inferences drawn from the environmental impact assessment of the proposed project during various phases of project advancement, such as design, location of project, construction and regular operations. It also describes the overall impacts of the proposed project activities and underscores the areas of concern, which need mitigation measures

Chapter 5: Analysis of Alternatives (Technology & Site)

The technology and project site alternatives are discussed in the chapter.

Chapter 6: Environmental Monitoring Program

The chapter discusses various environmental aspects and the likelihood and severity of any potential impact including but not limited to protected areas, water resource, waste etc together with mitigation measures. Identification of various materials and processes during construction and operation of

power plant which can lead to safety and health issues have been brought out and mitigation measures have also been delineated in this chapter.

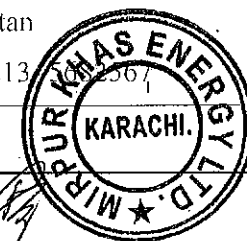
Chapter 7: Environmental Management Plan (EMP) and Monitoring Plan; Conclusion

It also provides recommendations/ Environment Management Plan (EMP) including mitigation measures for minimizing the negative environmental impacts of the project. The assessment will cover the baseline data generation, predictions and evaluation of impact on various environmental components and preparation of adequate Environmental Management Plan. For ongoing processes monitoring recording and monitoring of variable have also been stated. In conclusion, all the potential impact have been stated pertaining to air emissions, water resources, waste water, hazardous materials. Various activities have been suggested to cushion the impact on environment. At the same time, the need to set up plans and procedures to ensure compliance per industrial regulations, health and safety regulation identified to be made and put in place at construction and operation phase of the power plant. Monitoring.

On the basis of the study and the stated measures associated with plant construction and operation, the 26 MW bagasse fired power plant is recommended to be given Initial Environment Examination clearance. More so, because it is adjacent to the Mirpurkhas Sugar Mill, and at a site which stands cleared previously for stated industrial activity. This it is an extension of industrial activity. Furthermore, due to firing of clean fuel (bagasse) the project is expected to earn carbon credits. In conclusion, as environmental consultants, we consider that consent may be given by the concerned regulatory authority as the project meets the requirements laid down in the Initial Environment Examination

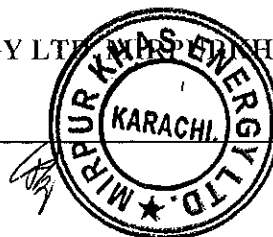
Consolidated Statement on various Environmental Aspects for Industrial Projects

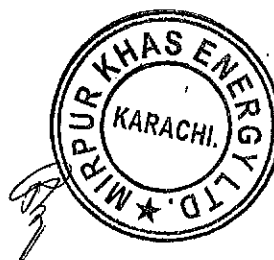
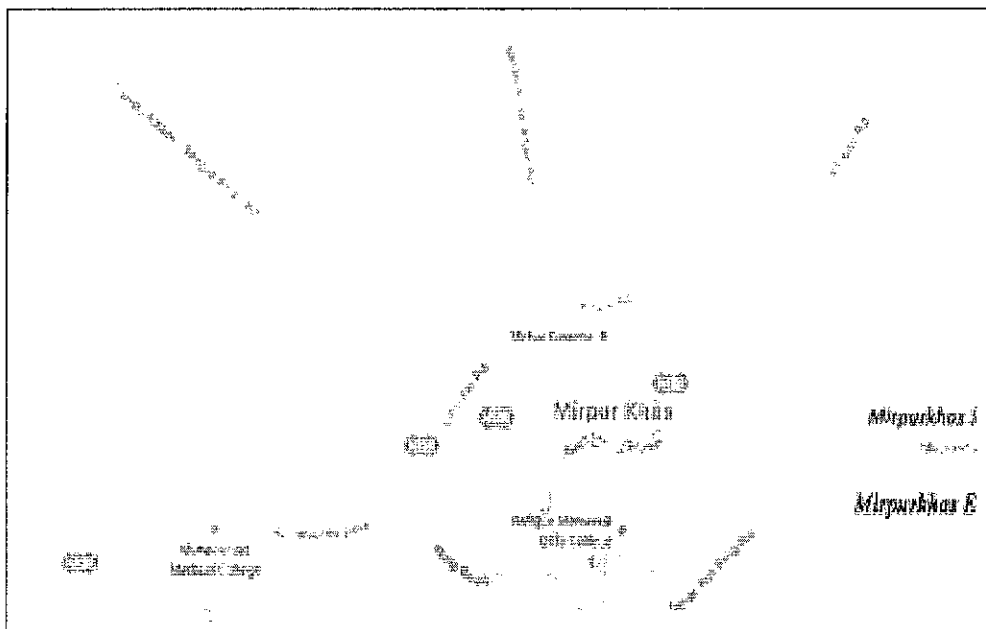
Sr. No	Particulars	Commitment On
	Name of Project:-	Bagasse Based Co-generation Power Plant by: M/s Mirpurkhas Energy Limited, Mirpurkhas Sindh
	Name, address, contact number & address of Proponent:-	Head office: Modern Motors House, Beaumont Road, Karachi, Sindh, Pakistan Tel No. 92-213 3367



		Fax No. 92-213-5682839
	Location of Site	Sub Post Office Sugar Mill, Jamrao, Umerkot Road, Taluka Hussain Bux Mari, District Mirpurkhas, Sindh Tel: +92 233 862961-2 873060 Fax: +92 233 873062
	New Project / Expansion in existing project/ Modernization/ Diversification in exiting project	New Project
	If expansion/ Diversification, whether environmental clearance has been obtained for existing project (If yes, enclose a copy with compliance table)	NA
	Area Details	Total plot area : ----- 20 acres. Covered Area: ----- will inform when get Drawing.
	Location details of the project :	Latitude : 25.5291° N, Longitude : 69.0136° E Location : Taluka Hussain Bux Mari, District Mirpurkhas, Elevation above Mean Sea Level: 17 meters
	Distance from Protected Areas / Critically Polluted areas / Eco-sensitive areas / inter-State boundaries	There are no Protected areas / Critically polluted areas / Eco-Sensitive areas/ inter-state boundaries within 10 Km radial area
	Raw materials (including process chemicals, catalysts, & additives)	Raw materials Bagasse nature of raw material Fibrous material Approx. Quantity (tonnes/year) full Season (120 days) MT Off-season (75 Days): MT 88000

LOCATION MAP OF MIRPURKHAS ENERGY LTD. MIRPURKHAS, SINDH





LEGISLATIVE & REGULATORY ASPECTS

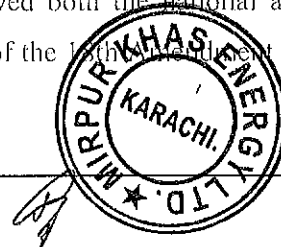
2.1 PREFACE

Legal and Institutional Framework in Pakistan, the history of legislation drafted specifically to protect the environment dates back to 1980s. This section provides a brief historical and constitutional context followed by a detailed discussion of relevant laws.

Historical and Constitutional Context

The development of statutory and other instruments for environmental management has steadily gained priority in Pakistan since the late 1970s. The Pakistan Environmental Protection Ordinance, 1983 was the first piece of legislation designed specifically for the protection of the environment. The promulgation of this ordinance was followed, in 1984, by the establishment of the Pakistan Environmental Protection Agency (Pak-EPA), the primary government institution at that time dealing with environmental issues. Significant work on developing environmental policy was carried out in the late 1980s, which culminated in the drafting of the Pakistan National Conservation Strategy. Provincial environmental protection agencies were also established at about the same time. The National Environmental Quality Standards (NEQS) were established in 1993. In 1997, the Pakistan Environmental Protection Act (PEPA) 1997 was enacted to replace the 1983 Ordinance. PEPA conferred broad-based enforcement powers to the environmental protection agencies. This was followed by the publication of the Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations 2000 which provided the necessary details on the preparation, submission, and review of initial environmental examinations (IEE) and environmental impact assessments (EIA) reports.

Prior to the 18th Amendment to the Constitution of Pakistan in 2010, the legislative powers were distributed between the federal and provincial governments through two 'lists' attached to the Constitution as Schedules. The Federal list covered the subjects over which the federal government had exclusive legislative power, while the 'Concurrent List' contained subjects regarding which both the federal and provincial governments could enact laws. The subject of 'environmental pollution and ecology' was included in the Concurrent List and hence allowed both the national and provincial governments to enact laws on the subject. However, as a result of the 18th Amendment this subject is



now in the exclusive domain of the provincial government. The main consequences of this change were as follows:

- The Ministry of Environment at the federal level was abolished. Its functions related to the national environmental management were transferred to the provinces. To manage the international obligations in the context of environment, a new ministry—the Ministry of Climate Change—was created at the federal level.
- The PEPA 1997 was technically no longer applicable to the provinces. The provinces were required to enact their own legislation for environmental protection. However, to ensure legal continuity PEPA 1997 continued to be the legal instrument for environmental protection in the provinces till enactment of provincial law.

All provinces have now enacted their own environmental protection laws. These provincial laws are largely based on PEPA 1997 and, hence, provide the same level of environmental protection as the parent law. The provincial assembly of Sindh passed the Sindh Environmental Protection Act 2014 (the 'Sindh Act 2014') in March 2014.

Between 1993 and 2010, the Pak-EPA promulgated several rules, regulations, standards, and guidelines to implement the provisions of the PEPA 1997. It is understood that these instruments remain applicable in Sindh, unless they are superseded by a new instrument. In Sindh two such instruments have been promulgated, as will be discussed later in this chapter.

The discussion on regulatory requirements applicable to this project is, therefore, based on the Sindh law, the Sindh Environmental Protection Act 2014 and the rules, regulations, standards, and guidelines developed under the PEPA 1997 and the two instruments promulgated by the Government of Sindh.

2.2 ENVIRONMENTAL LAWS

The Sindh Environmental Protection Act 2014 (Sindh Act 2014) is the basic legislative tool empowering the government to frame regulations for the protection of the environment. The act is applicable to a broad range of issues and extends to air, water, industrial liquid effluent, marine, and noise pollution, as well as to the handling of hazardous wastes. The sections of Sindh Act 2014 that have a direct bearing on the proposed Project are listed below. The details are discussed in the following sections.

- Section 11 that deals with the Sindh Environmental Quality Standards (SEQS) and its application

- Section 13 that deals with hazardous substances
- Section 14 that prohibits various acts detrimental to the environment
- Section 15 that relates to vehicular pollution
- Section 17 that establishes the requirement for environmental impact assessment

Implementation of the provisions of the Sindh Act 2014 is made through several rules and regulations. The relevant rules and regulations are:

- National Environmental Quality Standards (Self-Monitoring and Reporting by Industries) Rules, 2001
- Environmental Samples Rules, 2001
- The Pollution Charge for Industry (Calculation and Collection) Rules, 2001
- Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2014
- (IEE-EIA Regulations 2014) Guidelines are issued by the Pak-EPA for preparation of environmental assessment.

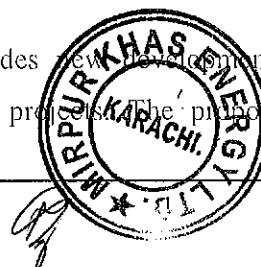
2.3 REQUIREMENTS FOR ENVIRONMENTAL IMPACT ASSESSMENT

The articles of Sindh Act 2014 that have a direct bearing on the environmental assessment of the proposed Project are:

- Article 17(1): 'No proponent of a project shall commence construction or operation unless he has filed with the Agency an initial environmental examination or an environmental impact assessment, and has obtained from the Agency approval in respect thereof.'
- Article 17(3): 'Every review of an environmental impact assessment shall be carried out with public participation...'

The IEE-EIA Regulations 2014 provides the necessary details on the preparation, submission, and review of the IEE and the EIA. Categorization of projects for IEE and EIA is one of the main components of the IEE-EIA Regulations 2014. Projects have been classified on the basis of expected degree of adverse environmental impact. Project types included in Schedule II of the regulations those that are likely to have potentially significant impact on the environment and thus an EIA is required for such projects, whereas those included in Schedule I as having potentially less adverse effects and therefore require an IEE.

The word 'project' as defined in the Sindh Act 2014 includes new developments as well as modifications, expansions and rehabilitations of the existing projects. The proposed Project is



considered a new development and not a modification to the existing Project because it will have its own separate staff, resources, financing, accounting, utilities, and administrative control. None of these items will be shared. Hence the proposed 26 MW bagasse based new power project is not the subject of this EIA. It falls under Schedule I and an Initial Environment Examination report is required to obtain the Consent from concerned agency.

Regulation 9 of the IEE-EIA Regulations 2014 requires that:

Ten paper copies and two electronic copies of a IEE or EIA shall be filed with the Federal Agency; every IEE and EIA shall be accompanied by:

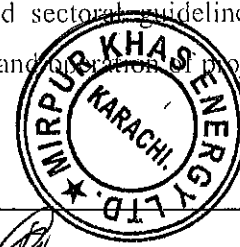
- a. An application, in the form set out in Schedule V;
- b. Copy of receipt showing payment of the review fee;
- c. No objection certificates from the relevant departments in case of EIA shall be the part of reports; and
- d. The environmental check list as per its guidelines.

The prescribed procedure for review of EIA by the EPA is described in Regulations 10–17. The key features are:

- On acceptance of the EIA for review, EPA will place a public notice in national English and Urdu newspapers and in local language newspaper informing the public about the project and where it's EIA can be accessed. It will also set a date for public hearing which shall be at least 30 days after the publication of the notice
- If it considers necessary, the EPA can form a Committee of Experts to assist the EPA in the review of the EIA. The EPA may also decide to inspect the project site
- Article 17(4) of SEPA Act 2014 binds the SEPA to 'communicate its approval or otherwise ... within a period of four months from the date the environmental impact assessment is filed complete in all respects in accordance with the regulations, failing which ... the environmental impact assessment shall be deemed to have been approved, to the extent to which it does not contravene the provisions of this Act and the rules and regulations'.

Regulation 7 of the IEE-EIA Regulations 2014 pertains to the guidelines. It states that:

1. The Agency may issue guidelines for preparation of a IEE or EIA or an environmental checklist, including guidelines of general applicability and sectoral guidelines indicating specific assessment requirements for planning, construction and operation of projects relating to a particular sector.



2. Where guidelines have been issued under sub-regulation (1), an IEE or EIA shall be prepared, to the extent practicable, in accordance therewith and the proponent shall justify in the IEE or EIA or in environmental checklist any departure there from.' The relevant guidelines are the follows

Policy and Procedures for the filling, review, and approval of environmental assessments sets out the key policy and procedural requirement. It contains a brief policy statement on the purpose of environmental assessment and the goal of sustainable development and also states that environmental assessment be integrated with feasibility studies.

Guidelines for the preparation and review of environmental reports which cover the following:

- Scoping, alternatives, site selection, and format of environmental reports;
- Identification, analysis and prediction, baseline data, and significance of impacts;
- Mitigation and impact management and preparing an environmental management plan;
- Reporting;
- Review and decision making;
- Monitoring and auditing;
- Project management.

Guidelines for sensitive areas which identifies the sensitive areas

Sectoral Guidelines for Environmental Reports-Thermal Power Stations deal with major thermal power plants which will be defined as those producing electrical energy from fossil fuels (coal, gas, oil). The guideline is prepared to assist project proponents to identify the key environmental parameters those are required to be addressed to develop mitigation measures and alternatives that need to be considered in the actual EIA. Again, the proposed project being bagasse fired does not fall under this category.

Hazardous Substances

Article 13 of the Sindh Act 2014 states that 'Subject to the provisions of this Act, no person shall import, generate, collect, consign, transport, treat, dispose of, store, handle or otherwise use or deal with any hazardous substance except—(a) under a license issued by the Agency; or (b) in accordance with the provisions of any other law for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Government is a party.'

Hazardous substance is defined in Article 2(xxv) of the Sindh Act 2014 as "(a) a substance or mixture of substances, other than a pesticide as defined in the Agricultural Pesticides Ordinance, 1971 (II of

1971), which, by reason of its chemical activity or toxic, explosive, flammable, corrosive, radioactive or other characteristics, causes, or is likely to cause, directly or in combination with other matters an adverse environmental effect; and (b) any substance which may be prescribed as a hazardous substance

To date, SEPA (Sindh Environment Protection Agency) has not prescribed any substance as hazardous nor has it defined the procedure for licensing. As and when, the procedure is defined and a license for any particular substance being used at the power plant is required, license will be obtained by the project proponent. However, best industry practice and internationally acceptable guidelines for hazardous substances would be used for the proposed MEL project.

2.4 ENVIRONMENTAL STANDARDS

Article 11(1) of the Sindh Act 2014 states that: 'Subject to the provisions of this Act and the rules and regulations, no person shall discharge or emit or allow the discharge or emission of any effluent, waste, pollutant, noise or any other matter that may cause or likely to cause pollution or adverse environmental effects, as defined in Section 2 of this Act, in an amount, concentration or level which is in excess to that specified in Sindh Environmental Quality Standards...'

Between 1993 and 2010, the Pak-EPA promulgated several standards, the NEQS, which were applicable to the entire country. These include:

- Ambient air quality (9 parameters)
- Drinking water (32 parameters)
- Ambient noise
- Industrial effluents (32 parameters)
- Industrial gaseous emissions (18 parameters)

Following the promulgation of Sindh Act 2014, Sindh has notified its own ambient air quality standard. It is understood that the NEQS issued prior to Sindh Act 2014 remain in force in Sindh unless they are expressly amended, as is the case with the ambient air quality standards. As the Sindh Act 2014, does not have the provision for a national standard and PEPA 1997 is no longer applicable in Sindh, the term 'Sindh Environmental Quality Standards' is understood to include the NEQS (except ambient air quality standards) issued under PEPA 1997. However, the term NEQS is still used in this document where reference is made to older standards.

All industrial standards (ambient air quality, gaseous emission, ambient noise and industrial effluent) are applicable to the proposed MEL Plant. These are further discussed in chapter 3.10



Under the National Environmental Quality Standards, Self-Monitoring and Reporting (SMART) by Industry Rules 2001, industrial units are responsible for monitoring their gaseous and liquid discharges and reporting them to the relevant environmental protection agency. As fuel and coal fired thermal power plant falls under the Schedule II Category (Category A) of industrial categorization and reporting procedure for SMART, environmental monitoring reports required to be submitted in monthly basis to the relevant authorities. The project proponents will report their emission and effluent to the SEPA in accordance with the rules.

Other Laws

The scope of environmental law implied by the legal definition of „environment“ given in PEPA 1997 results in enactment of various environmental laws. These include laws pertaining to forests, water resources, wildlife, land, agriculture, health and town planning. Laws that may have relevance to environment with a brief scope of the law and their applicability are listed in Exhibit 2.1.

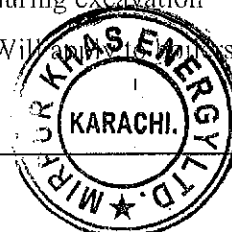
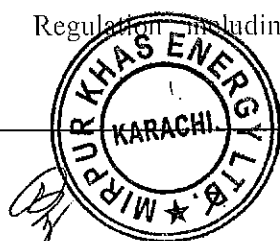
Water Law

Most of the law on water allocations and use in Pakistan is not relevant to the Project because it applies to water needed for irrigation. In the last decade, water law in Pakistan has been under review with a National Water Policy published in 2003, which identifies the following needs for the regulation of industrial use of water:

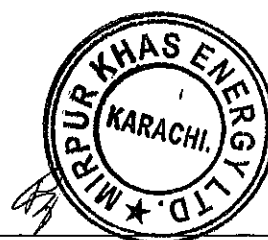
- Make available and reserve sufficient supplies of water for industry on priority basis to promote industrial development and economic growth; and Enact legislation to formally allow and define the use of water abstraction licenses and water rates for industrial use.
- Although specific regulations have been developed for sharing of irrigation water in Sindh, these are not applicable to non-irrigated areas such as Thar.

Exhibit 2.1: Key Environmental Laws in Sindh

Legal Instrument	Scope and Applicability	Relevance
The Antiquities Act 1975 and Sindh Cultural Heritage Act 1994	Preservation and protection of antiquities (any object more than 75 years old). Empowers the government to declare any antiquity as protected	There is no protected antiquity at the proposed site of power plant or its surroundings. Will apply to any chance find of archaeological resource during excavation
Boiler Act 1923 and Boilers	Regulation including safety	Will apply to boilers in the



Act (Sindh Amendment) Ordinance 1971	of boilers (any closed vessel exceeding 23 liters in volume) used for generating steam	power plant
Canal and Drainage Act 1873 and Sindh Irrigation Act 1879	Regulates all surface water bodies (both natural and constructed using public resources).	Not applicable since there are no perennial surface water bodies in the project area of influence
Electricity Act 1910, Electricity Rules 1937, and NEPRA Act of 1998	Regulates production, transmission, distribution, and use of electricity	Applicable to the Project including sections relating to safety.
Forest Act 1927	Regulates forest resources. Empowers the government to declare any forest area reserved or protected.	No relevance as there are no reserve or protected forest in the project area of influence
Land Acquisition Act 1894	Empowers the government to acquire private land for projects of national importance and lays down the acquisition procedure	Not in the scope of the project
Petroleum Act 1934	Regulates import, transportation, storage, production, refining and blending of petroleum products and other flammable substances	Storage of petroleum products at the power plant site will be governed by this law
Sindh Wildlife Protection Ordinance 1974	Empowers the government to take measures for protection of wildlife in the province by declaring setting aside certain areas as national park, wildlife sanctuary, and game reserve, and by declaring certain species as protected.	There are no protected areas in the project area of influence. The Rann of Kutch Wildlife Sanctuary is at least 5 km from the site.



Sindh Water Management Ordinance 2002	“To provide for the establishment on long term, sustainable and participatory basis, of public systems for the distribution and delivery of irrigation water, the removal of drainage water and the management of flood waters”	No relevance to the Project
Mines Act 1923	Regulates mines	Not relevant to the power plant

2.5 LABOR, HEALTH AND SAFETY LEGISLATION

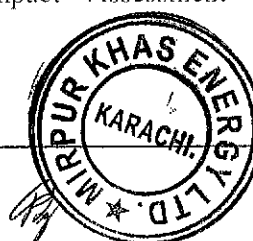
The Constitution of Pakistan contains a range of provisions with regards to labor rights, in particular:

- Article 11 of the Constitution prohibits all forms of slavery, forced labor and child labor;
- Article 17 provides for a fundamental right to exercise the freedom of association and the right to form unions;
- Article 25 lays down the right to equality before the law and prohibition of discrimination on the grounds of sex alone; and
- Article 37(e) makes provision for securing just and humane conditions of work, ensuring that children and women are not employed in vocations unsuited to their age or sex, and for maternity benefits for women in employment.
- Labor law is controlled at both provincial and national levels with compulsory employment agreements containing the terms set out by the labor laws. There are various laws containing health and safety requirements including: Mines Act 1923; Factories Act 1934; Factories Rules; Hazardous Occupations Rules 1963; Provincial Employees Social Security Ordinance 1965; and Workmen’s Compensation Act 1923. No single comprehensive piece of legislation deals with occupational or community safety and health.

2.6 FEDERAL LAWS

Pakistan Environmental Protection Act, 1997

The Act was promulgated on December 06, 1997 by repealing the Pakistan Environmental Protection Ordinance of 1983. Section 12 of the Act provides for environmental assessment study: Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) prior to commencement of construction or operation of a project.



Project Implementation and Resettlement of Affected Persons Ordinance (draft) In order to provide legislative support to National Resettlement Policy; Government of Pakistan has also drafted Project Implementation and Resettlement of Affected Persons Ordinance but has not yet promulgated. The provisions of this draft ordinance are consistent with the requirements of the World Bank's OP 4.12 on involuntary resettlement. After becoming law, these provisions will apply when addressing the resettlement issues that arise in the project.

Cutting of Trees (Prohibition) Act, 1975

This Act prohibits cutting or chopping of trees without permission of the Forest Department

The Antiquities Act, 1975

Archaeological sites and monuments are specifically protected by this Act.

Land Acquisition Act, 1894

The Land Acquisition Act (1894) deals with the acquisition of private properties for public purposes including large development projects like major roads. There are 55 sections in this Act mainly dealing with area notifications, surveys, acquisition, compensation, apportionment awards, disputes resolution, penalties and exemptions

Canal and Drainage Act, 1873

This Act entails provisions for the prevention of pollution of natural or man-made water bodies.

Pakistan Penal Code, 1860

This Act defines the penalties for violations concerning pollution of air, water bodies and land.

Explosives Act, 1884

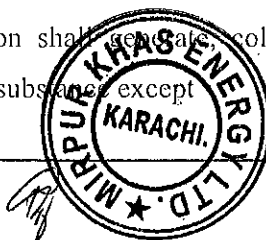
Under the Explosives Act, 1884, the project contractors are bound by regulations on handling, transportation and using explosives during quarrying, blasting, and other purposes.

Highways Safety Ordinance, 2000

This ordinance includes provisions for the licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control, offences, penalties and procedures; and the establishment of a police force for motorways and national highways charged with regulating and controlling traffic on the national highways, and keeping the highways clear of encroachments.

Hazardous Substance Rules, 2003

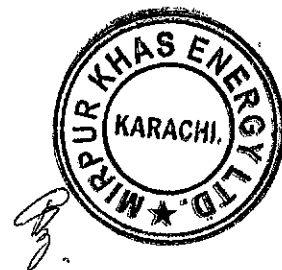
(Draft) Section 14 of the PEPA 1997 requires that "no person shall generate, collect, consign, transport, treat, dispose of, store, handle or import any hazardous substance except



- a. Under a license issued by the Federal Agency and in such manner as may be prescribed; or
- b. In accordance with the provisions of any other law for the time being in force, or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Pakistan is a party.” Pak-EPA has drafted the Hazardous Substance Rules to implement the licensing requirement. The rules are still in their draft form and are pending notification.

Environmental Standards and Guidelines Applicable to the Projects

All projects are legally required to comply with the SEQS for gaseous emission, and liquid effluent, and SEQS for ambient air quality. The environmental standards applicable in Sindh are SEQS as developed by Sindh Environmental Protection Agency after 18th Amendment. In addition to Sindh Environmental Protection Agency has separately notified the ambient air quality standards.



BASELINE ENVIRONMENTAL STATUS

3.1 INTRODUCTION

A comprehensive understanding of the physical, chemical, and biological environment provides the foundation to a well-executed Initial Environmental Examination. Baseline information in the areas of aquatics, flora and fauna, hydrology, hydrogeology, meteorology, air quality and water quality is collected using secondary literature as well as surveys conducted in the Study Area

The detailed baseline characterization is used as input to model possible project impacts, which allows providing timely input to project designs to reduce potentially adverse environmental impacts. This in turn produces a more socially and environmentally sustainable project and enhances the efficiency of the project permitting process.

3.2 METHODOLOGY OF ENVIRONMENTAL BASELINE SURVEY

The environmental assessment (examination and evaluation) is primarily based on simple comparative evaluation approach. Initially the baseline or profile of the projected area is developed by the site visits, collecting data, records and information on physical and ecological environment. The same data is then projected (exploited) as baseline information with respect to environment for the evaluation, identification assessment of significant impact either in qualitative or quantitative manner is carried out for which appropriate mitigation measure are proposed.

Site Visits/ Survey

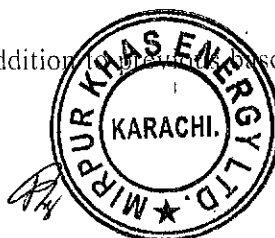
The environmental assessment team comprising of group of experts made a number of facts finding and sample collection visits to the factory to collect baseline data in extent to environmental aspects.

3.3 SCOPE

Consultation with clients

Preliminary survey of the site has been done in which general environmental issues and sensitivity of the factory area have been assessed;

All possible archives and published literature is consulted in addition to baseline studies on sugar factories.



Project location

Newly proposed plant to produce 26 MW power is to be set up on 20 acres land adjacent to the existing Mirpurkhas Sugar Mill, Mirpurkhas.

District Mirpurkhas

Lying on the Let Wah Canal at 25°31'39.3"N 69°00'50.6"E, Mirpurkhas is the gateway to the south-eastern edge of the Sindh province. It connects to Hyderabad at 65-kilometres by both road and rail while with Umerkot it connects only by road. Karachi is 220-kilometres south-west of the town. On the extreme east lies the Indian border at 170-kilometres. It is bounded on the north by the district of Sanghar in the east by the newly created district Umerkot bordering the Bermet/Marwar and Jaisalmir district of India. It is bounded on the West by Tando Allah Yar and Hyderabad districts, on the South by Badin and Tharparkar districts.

Mirpurkhas is positioned atop a fertile land making conditions apt for farming and irrigation. Being connected to the Indus via irrigation canals like the Let Wah, Mirpurkhas has gained an advantage in horticulture and farming over the years. Primary produce includes emangos (famous for producing mangoes), sugarcane and cotton, wheat, & chilies. Bananas are also widely cultivated around the region and also one of the biggest producers of Bananas in the country.

3.4 SOCIO-CULTURAL ENVIRONMENT

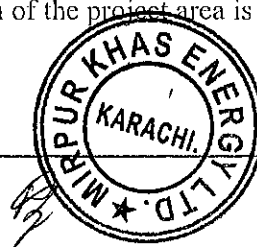
Ethnicity/Tribes of the project area

The population of the project area is a mixture of various heterogeneous groups and cultures. The main tribes are Talpur, Memon, Syeds Baluchs, Somra, Mirzas, Sheikh, Khattris, Qureshis, Abbasis, Bhurgari, Lashari, Laghari, Ranghar, Panwhar, Halepota, Mari, Banglani, Gorchani, Khosa, Sameja, Gurgaj, Bhanb

Jat, Arian, Qurush and Sheikh. A lot of people from Punjab and NWFP have settled in the project area. Different groups of minorities are also found settled in large scale of the project area. They are mostly Kohlies, Bheels and Maighwars

Main Occupation of the project area

Mirpurkhas is an industrial cum agriculture city, providing opportunities to different occupations. The occupation adopted by the people varies from agriculture to business and form public related sectors to their involvement in industries. However, the main occupation of the project area is agriculture



Religion Ratio in Project Area

The main religious groups in Mirpurkhas district are Muslims and Hindus. The Muslims are in majority of the project area. However, Hindus particularly Jati are the second biggest community in the project area.

Mother Tongue/ Language

Sindhi is the major mother tongue in the project area which is spoken by majority of population. A large community does speak and understands Urdu and Punjabi mainly in urban areas

3.5 PHYSICAL ENVIRONMENT

Demographic characteristics

The Mirpurkhas District is spread over 2991 sq. km., that is, 2.10% of the total geographical area of Sindh, but its share in total Population in 1998 accounted for 899947 souls or 3% of the provincial population. It increased by 54% during 1981-98 intercensal periods a span of 17 years at an average annual growth rate of 2.59%. In accordance with the land area of Mirpurkhas district i.e. 2991 sq. km., there is density of 303 persons per sq. km. as compared to 196 persons per sq. km. in 1981. Out of its total population 291951 persons or 32% are settled in urban areas and remaining 607996 persons or 68% are located in rural areas. The sex ratio (male per 100 females) is worked out at 108; this ratio is also constituted of 109 males in rural and 106 in urban areas respectively. According to 1998 population census, there are total 152404 households in Mirpurkhas district comprising of 899947 persons thus giving an average size of six persons per household.

Topography

Almost all the barrage (irrigated) area falls in the district Mirpurkhas which is conducive to Agriculture Cultivation and happen to be more densely populated with 108 persons per square km. few industries which exist in the district mainly comprise of Cotton Ginning and Oil Mills mainly concentrated in the barrage area. There is no Engineering industry in whole of the district and the average per capita income is low as compared to other districts. Similarly, road and rail services are largely concentrated in the Barrage area, although even there, they are unevenly distributed. The Barrage zone itself does not have a river, but a natural inundation canal, locally called the Nara Dhoro (Eastern Nara Canal) flows through the district without entering the desert zone and through a network of channels provide water for drinking and irrigation purpose.

Geology

The deposits contain small sized rounded pebbles of sandstone, quartzite or granite and sand mixed or alternating with clayey deposits. They have been described as alluvial deposits, but it is equally

probable that they have a glacial origin. The soil of the project area is silt clay and highly fertile land of high productivity especially in the barrage area of district Mirpurkhas.

3.6 CLIMATOLOGY

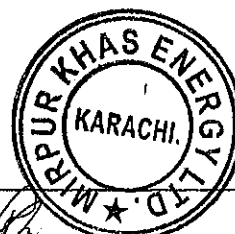
Climate

The district has extremes of the climate. However, the climate differs considerably in barrage areas. In the irrigated western portion it is comparatively less hot in summer and less cold in winter as compare to the western desert area. The summer heat is considerably neutralized by constant blowing of the south western sea breezes. April, May and June are the hottest months during the day time; however, nights are cold and pleasant. The mean maximum and minimum temperature during this period are 41°C and 26°C respectively. December, January and February are the coldest months. The mean maximum and minimum temperature during the period are 28°C and 9°C respectively.

A rainfall varies from year to year. Precipitation months (Monsoon) in the region are between June and September. The winter's rains are in significant. The mean maximum and minimum temperature and precipitation recorded is given below:

Table 3.1: Overview of Climate

Months	Mean Temperature	Precipitation (Mini)	Precipitation (Max)
Jan	25.6	1.0	7.6
Feb	29.5	2.0	10.7
March	35.3	1.0	16.6
April	39.9	1.0	20.7
May	42.4	1.0	25.0
June	40.8	10.0	27.3
July	37.2	26.8	50.0
Aug	35.1	23.8	76.0
Sep	36.2	23.0	24.2
Oct	36.4	5.0	20.1
Nov	32.3	1.0	13.9
Dec	27.4	1.0	8.7
Annual	34.8	34.8	172.0



Humidity

July, August and September are the most humid months in the area, whereas May and June are the less humid months.

Rainfall

The annual rainfall in the project area ranges between 177.75 mm and 231.97 mm. Maximum rainfalls (about 60% of the total annual) occurs during the Monsoon season (July, August and September), while the period of minimum rainfall or drier period is October and November.

Soil

Particle size distributions show that most of the soil profiles had layers with clay, silty clay loam, and loam and clay loam textures. The main reasons for this particle size distribution pattern in the study area was possibly due to the nature of the parent material, the eluviations, alleviation and also may be some faunal activities. It is evident that the soils of lower Indus Plain contain more clay. Similar soil texture trend is also observed in salt-affected soils of Hyderabad district, the area adjacent to Badin district.

At all depths, soil was slightly alkaline in reaction and showed pH range of 7.3 to 8.5. The alkaline pH was possibly due to the presence of high CaCO_3 , as soils of the area were calcareous in nature the general pattern of CaCO_3 distribution in all profiles was irregular. The organic matter content was found to be $< 1\%$ in all opened pits, however, the upper layers contained more organic matter than the bottom most layers. Low organic matter content observed in these soils was possibly due to the lack of vegetation, except availability of some halophyte species such as *Suaeda fruticosa*, *Alhaji mororum*, etc. In general $\sim 2\%$ organic matter is considered necessary for productive soils but in the arid lands, it always remains $< 2\%$. Several other research workers have reported similar properties of salt-affected soils of Sindh province.

Compared to sub-soil and bottom layers, all soil profiles had high salinity problem in top most layers and show efflorescence of salts at surface. Surface efflorescence indicates the accumulation of soluble salts possibly brought by salty groundwater to the surface. Capillary rise of salty groundwater to the surface and accumulation of salts on surface has long been reported in arid soils. In some areas soil was found deeply saline and showed high ECe values throughout the layers; but the other profiles had high salinity in top layers only.

Although, the concentrations of Na^+ and Cl^- remained high in top layers, both Na^+ and Cl^- followed by SO_4^{2-} and HCO_3^- were found to be the dominant ions in almost all layers. Carbonates (CO_3^{2-})

generally remained absent in almost all soil samples, except only in those soil samples taken from bottom layers. The distribution of HCO_3 generally remained uneven and irregular throughout the soil profiles.

Land Utilization

The pattern of land use in a region determines crop production. Soil & climate play an important role in the management of cropping pattern of a region. Crop area used for food and cash crops can be taken as an index of the type of land system and the economic use for these crops. The reported area in Mirpurkhas remained unchanged since in 1993-94 and recorded at 299.1 thousand hectares in 1997-98. However, not all of this area is cultivable. 32.1% was reported as "uncultivable" though its share was 31.0% in 1993-94.

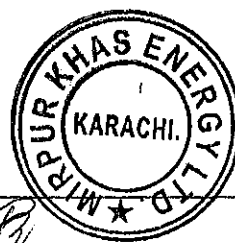
The share of cultivated area (in the area reported) decreased from 69.0% in 1993-94 to about 67.9% in 1997-98. It, however, is still smaller as compared to over all Sindh. From the data one can infer that the cropping intensities did not changed significantly since many years, therefore, an acre of land in Mirpurkhas district is not cropped fully once in a year. However, the cropped area increased from 110.9 thousand hectares in 1993-94 to 117.0 thousand hectares in 1997-98. The cropping intensity is recorded at 57.6% reflecting higher cropping intensities, as compared to rest of Sindh. The cropped area increased by about 5.5%, on the contrary the cultivated area also slightly decreased by 1.7% during the period of five years.

A small part of the area about 0.07% is being used for grazing or forest and remaining land is lying unused due to unfavorable condition or lack of irrigation water. It is noted that the pressure of total rural population on cultivated area has increased considerably since last many years. The ratio of cultivated area per person decreased from 0.30 in 1993-94 to 0.22 in 1997-98.

Surface Water

The only river flowing in the province of Sindh is the Indus, which runs along the Western boundary of the district. It enters Sindh rushing through the gorge between Sukkur and Rohri in the lime stone rocks, and from here it flows comparatively calmly with two arms-known as Eastern Nara and Western Nara, and changes its direction to South-east, till it reaches Kotri. However, there is no river or stream in Mirpurkhas district. The Mir Wah and branches of Nara canal irrigate the district. The Jamrao West branch canal flows along the Western boundary of district and irrigate Western part of the district Mirpurkhas.

Ground Water



The project area has plenty of water and the ground water table is high as it lies in Indus River Basin. In some areas the ground water table is low, especially in the Kirthar lime stone (middle Eocene) range, where water shortage is common and always a drought like situation is prevailed. Some parts of Sindh are facing severe water logging and salinity problem which has disturbed the ground water quality. Ground water extraction is very common practice for domestic and agriculture usage. Normally, the ground water depth varies from 40-150 ft at different locations in the project area.

Water Supply and Drainage

Potable Water Supply is a pre-requisite for the health of people. Lack of proper drinking Water Supply and Sanitation in rural as well as urban areas has caused wide spread water borne diseases of which diarrhea among small children happens to be a major killer. These diseases are transmitted by water and poor sanitation which deplete human energy resulting in sickness reducing thereby the productivity of the people. The position with regard to drinking water is not so acute in the Mirpurkhas District the Nara canal from the River Indus has been harnessed to provide irrigation for the long stretches of land in the district. This also provides a source of drinking water to a large number of people.

Urban Drainage

As regards the urban drainage system in District Mirpurkhas, almost all urban localities have been facilitated by drainage facility.

Rural Water Supply

The water supply facility in the rural areas of Sindh through a piped water system is to be provided according to the criteria which assigns priority to "A rural settlement with population of 1000 and above preferably having brackish ground water". In Mirpurkhas district, 75 rural settlement having population up to 1000 are categorized in to 3 type of settlements in descending order according to their size of population taking into account the quality of ground water.

Rural Drainage

Drainage system in the rural areas of Sindh under the prescribed criteria is provided for "A rural settlement with population 1000 & above preferable having water system".

Agriculture Sector

Pakistan's economy has undergone considerable diversification over the year yet the agriculture sector still constitutes its back-bone. With its present contribution to GDP at 24.87 percent, Agriculture accounts for half of the total employed labor force and are the largest source of foreign exchange earnings while it serves as the base sector for the country's major industries like textiles and sugar.

The economic development of Sindh is largely dependent on the progress and growth of Agriculture sector. Sindh province contributes significantly towards over all national agriculture with 26% of the cultivated area, 17% of the cropped area and 16% of the irrigated area, 19% of the total forest area, 43% of the total production of rice, 25% of cotton, 14% wheat, 30% sugar cane, 22% other food grains, 59% of marine fish, 60% of inland fish and 28% of the live stock production originates in Sindh. Lower productivity levels per hectare continue to be problem No. 1 of crop production. Over the last ten years period, most insignificant increases are noticeable in yield of major crops over several years in view of efforts undertaken to eradicate water-logging and Salinity, provision of new seed varieties, increased use of fertilizer, pesticides, provision of agriculture extension services and on-farm water management practice and close co-ordination among farmers and agricultural field staff. Achievements of self sufficiency in major crop production must, therefore, address to the key issue bottlenecks. The enhancement of yields in the shortest possible time needs to be taken by reviewing existing program by involving farming community in co-operative manners reducing reliance on extension staff.

Irrigation and farming was revitalized after the Jamrao Canal was built in the 1900s. The city was able to produce and cycle crops to supply mainly grain, cotton products like fabrics, and sugar from the sugarcane cultivations. For a certain period in history, Mirpurkhas enjoyed being the best cotton producer in the country and much of the income of the town came from cotton farming in its heyday.

The district has very fertile land and it produces wheat, onion, sugarcane, cotton, corn, mangoes and other crops. Though Mirpurkhas has small industrial park but no industry is functional over there. However, there are sugar mills, namely Mirpurkhas Sugar Mills, Al-Abass sugar mills, Digri Sugar Mills and Tharparkar Sugar Mills of them Mirpurkhas Sugar Mills is the oldest one.

Live Stock

Live Stock is one of the major sub-sector of Agriculture and back bone of our economy. It contributes roughly one third in the total share of Agriculture GDP. Its main by-products including hides and skins have substantial potential as semi-finished products. A substantial growth on Live Stock products such as milk, meat, beef, mutton, poultry and eggs have been notices since many years. It has been estimated that over three - fourths of the farm power comes from animals and they are used for most of the farm operations. Bullocks provide the draft power on farm and in transport around the villages. Most farmers traditionally keep a few heads of live stock ranging from bullocks for draft to buffaloes or cattle for milk and poultry for eggs & meat. There is a need for increasing the heads of live stock to supplement income by selling products. Production for market even at the expense of consumption at home has become quite common in many areas of Sindh. There are pockets of

organized live stock farming such as cattle farms (or colonies) and poultry farms, located mainly in the urban areas. Most other units are of small size and not well kept.

As per live stock census 1996, the population of cattle, buffaloes, sheep and goats in Mirpurkhas district were recorded at 176258, 218655, 88421 and 527963 respectively. The population of live stock grew by 2.1% cattle, 3.5% buffaloes, 3.4% sheep and 5.9% goats over the last live stock census enumerated in 1986.

Meat, hair, hides, skins and wool are the other major products of live stock. Beef is the most important source of meat. But most of this beef is produced from discarded old bullocks, milch cattle and buffaloes, and buffalo calves. Mutton comes next in the market place, and it is provided by a variety of goats and sheep.

During the year 1997-98 it was reported that 83762 animals were slaughtered in the Mirpurkhas district. Out of the total slaughtered animals, 8053 cattle, 10336 buffaloes, 11455 sheep and 53918 goats were slaughtered. It was estimated that 4.6% cattle, 4.7% buffaloes, 13.0% sheep and 10.2% goats were slaughtered out of the total livestock population in 1997-98. It was observed that slaughtering of animals was increased by cattle 35.9%, buffaloes 52.1%, sheep 23.3% and goats 79.8% over the period of five years.

In order to meet the requirements of meat and milk, live stock farming seems to be necessary in joint venture of public/private sector or helping private sector in importing the livestock for establishing live stock farms through loans on easy terms & conditions. The Mirpurkhas district posse's vast potential for establishing livestock farming in the district.

Inland Fisheries

For Inland fishing, main economic activity is practiced in rivers, lacks and ponds, etc. in Sindh province. Fish not only supplements protein deficiency of food but also earns foreign exchange for the country. Fisheries contribute to both the national income and export earnings.

Inland fish production has been increasing over the years. In Mirpurkhas district, the inland fish production registered an increase of 50.0% to in 1997 over the preceding year. It is reported that Mirpurkhas district contributes very negligible share of 0.01% on the total 91903 metric tons inland fish production of Sindh.

Forest

Forests are not only necessary for habitation of livestock population but also instrumental in improving environmental quality and dependable source for meeting domestic energy requirements of

fuel wood. Besides it helps in conservation of soils, improve environment by controlling pollution, cause rainfall and climatic changes supplement source of energy and stabilize gas and oil prices. The forestry program in Sindh envisages management of forest on commercial basis in the Riverine forests, irrigation plantation forests, and mangrove forests, development of Social Forestry, Agriculture, Coconut and Range lands.

Total forest area in Sindh is 1161 thousand hectares or 8.3% of the Sindh province area which is far below the desired ratio of 20 to 30 percent considered necessary for balanced ecology.

The per capita forest area being 0.039 hectare in Sindh province or 0.032 hectares in the country was also quite low as compared to the world average of about 1.0 hectare.

In Mirpurkhas District, the forest area is spread over 1.2 thousand hectares which is 0.1% of the total area under forest in Sindh in the year 1997-98.

Air Quality

There are no major anthropogenic sources of air pollution in the project area. Few industries are located in the vicinity of Digri which can contaminate air quality of the project area. Potential sources of air pollution in the project area are vehicle exhausts from the traffic on the existing Mirpurkhas Digri Road and the exhaust emissions from fuel/diesel vehicles. Generally the existing air quality is in acceptable limits. However, the ambient air quality at the location is well below the National Environmental Quality Standards and as such there is no short-term health risk associated with existing levels of traffic or the industrial activities.

Noise and Vibration

Major source of noise pollution is the traffic on the existing Mirpurkhas - Digri Road. Therefore, noise levels are expected to be within limits of Sindh Environmental Quality Standards (SEQS) of Pakistan. The noise level of the project site was recorded at various locations. The noise measurement recorded was 72 and 82 dB (A) which is within acceptable limits of the SEQS.

3.7 BIOLOGICAL ENVIRONMENT

Flora

The type of soil i.e. sandy, loamy, water logged or saline, and the amount of moisture available mainly governs the vegetation species. In the water logged areas between Jamrao Bridge and Mirpurkhas, where Tamarix aphylla is the dominant species which is followed by Haloxylon stocksii as the second dominant species of saline areas.

The project site is dominated by *Prosopis glandulosa* and *Salvadora oleoides* with small patches of *Calotropis procera* and *Aerva javanica*. At certain places, cultivated *Nerium oleander* and *Carissa opaca* are found. Similarly, thick plantation of *Azadirachta indica*, *Albizia lebbek*, *Ficus religiosa*, *Ficus bengalensis*, *Moringa oleifera*, *Eucalyptus camaldulensis* and *Cordia myxa* are frequently present specially on both side of the road.

At some places old tree plantations are limited to only one side or absent on both sides. For instance, 20 trees of *Albizia lebbek* (Shrin) and 36 trees of *Azadirachta indica* (Neem) are there, on single side of road towards Mirpurkhas, near Sabhu Musa next to Machi hotel. 32 old trees of *Ficus religiosa* (Peepal) are near Goth Ameer Ali about 46 kilometres from Hyderabad towards Mirpurkhas, and more than a dozen of *Acacia nilotica* (Babur) trees, at a distance of about 27 kilometres from Hyderabad. Cultivated orchards are also important vegetative areas that have environmental as well as social concerns due to their commercial value.

The dominant trees in Mirpurkhas districts are babul (*Populus euphratica*), ber (*Zizyphus numularia*) and several varieties of *Tamarix* like plai (*Tamarix gallica*) and jhao (*Tamarix diocia*), talhi (*Dalbergia sisoo*), kri (*Tamarix gallica*), karir (*Coparris aphylla*).

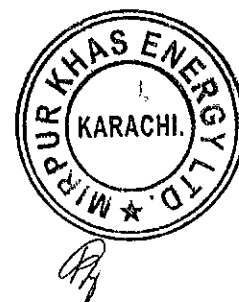
Number of ornamental flowers found in farms, gardens and elsewhere in the area are rose (*Rosa damascena*), jasmine (*Jasminum officinale*), and tuberose (*Polianthes tuberosa*) etc.

The area is mostly covered with weeds like *Tamarix aphylla* and *Salvadora persica* and exotic species like *Prosopis glandulosa*. Cutting/ clearance of these species has least concern. Old plantations of *Azadirachta indica* (Neem), *Albizia lebbek* (Shrin), *Ficus religiosa* (Peepal), *Acacia nilotica* (Babul), *Cordia myxa* (Lasura) and *Ficus benghalensis* (Borh) have special concerns.

As estimated of 111 plant species belonging to 41 families and 99 checklists of floral species with their local names, family name and life form. Poaceae family was found dominant with 18 vegetation species followed by Asteraceae having 7 species, Mimosaceae, Papilionaceae and Cyperaceae each having 5 while Malvaceae, Moraceae and Solanaceae each with 4 vegetation species from the project area. The Table 3.2 shows the number of floral species with dominant families. The Table 3.3 shows the life form status of all the 111 species that were observed during the field survey. The Table 3.4 shows percentage of each life form of the plant species in the project area.

Table 3.2: Number of species belonging to dominant families

No.	Family Name	No. of Species
1	Poaceae	18



2	Asteraceae	7
3	Mimosaceae	5
4	Papilionaceae	5
5	Cyperaceae	5
6	Malvaceae	4
7	Moraceae	4
8	Solanaceae	4

Table 3.3: Life form-wise breakdown of species

No.	Life Form	No. of Species
1	Herbs	39
2	Shrubs	19
3	Grasses	18
4	Trees	24
5	Climbers	3
6	Sedges	5
7	Creepers	3
	Total	111

Table 3.4: Percentage of life forms of the species in project area

S. No	Life form	Percentage %
1	Herbs	35.1
2	Grasses	16.2
3	Trees	21.6
4	Shrubs	17.1
5	Sedges	4.5
6	Creepers	2.7
7	Climber	2.7

Important commercial crops of the project area are *Saccharum officinale* (Sugar cane), *Brassica oleracea* (Cabbage), *Capsicum annum* (Chilli), *Gossypium sp.* (Kapaas), *Oryza sativa* (Dhaan), *Sorghum vulgare* (Jawar) and *Hibiscus esculentus* (Bhindi). Similarly, fruit orchards comprising of Chiku, Mangoes of various varieties including Chounsa, Sindhri, Dosehri, Langrha, Fajri, Almas, Malda saroli and Tota parri. Jaman and Ber trees are also commonly cultivated along boundaries of fruit orchards.

Fauna

The vegetation along road sides supports bird's species including *Ardeola grayii* (Herons), *Bubulcus ibis* (Egrets), *Centropus sinensis* (Crows), *Passer domesticus* (Sparrows), *Psittacula krameri* (Parakeets), *Pycnonotus cafer* (Bulbuls), *Acridotheres ginginianus* (Myna), *Pycnonotus cafer* (Lapwing), and indian scoops owl (*Otus bakkam-ovena*) by providing breeding as well as shelter place. Shrubs of *Salvadora pleoides* and *Prosopis gladulosa* provides good habitat to reptiles and

mammals as well as for their survival. During field visit, it is estimated that of 27 species of birds, 18 species of mammals and 10 species of reptiles were present in the area.

Birds

A total of 27 birds species were recorded during the survey through direct sighting or information from locals and Wildlife experts/ staff deployed in the area. The birds found from the project area are Indian/Common Myna, House Crow, Red vented Bulbul, Collard Dove, House sparrow Little Brown Dove and Indian Pond Heron were found common. Migratory birds have also been reported as migrants during winter season. No migratory bird species was sighted perhaps due to off season. During discussions with locals and Sindh Wildlife Department's staff, it was noted that populations of certain bird's species are declining due to human's disturbances particularly due to hunting activities which affect the population of Black pa

Mammals

There are 18 mammalian species which were recorded from the project area. The information was collected by direct sightings except of Indian Porcupine, Indian Grey Mangoos and Common Rats, while the rest of information was collected by witnessing the droppings of the concerned mammals, cages & paths and by interviewing the local people especially staff of Sindh Wildlife department deployed at Mirpurkhas and Hyderabad.

Reptiles

During the field surveys, 10 reptile species were recorded. Indian monitor, Agama and Garden lizard were recorded though direct sighting while others were reported by the local people and Wildlife Department staff.

Rare and endemic species

All species that are reported from the project area have a wide range of distribution in other ecological zones of country in general and Sindh province in particular. No endangered or threatened species have been reported from the project area during field visits.

3.8 ENVIRONMENTAL CONCERNS

In general, combustion of standard fossil fuels in commercial and industrial boilers results in the following emissions, CO₂, N₂, O₂, H₂O, CO, NO_x, SO₂, volatile organic compounds, and particulate matter. The latter five products of combustion are considered pollutants and are known to, either directly or indirectly, cause harmful effects on humans and the environment. In case of bagasse-fired boilers, the pollutants emitted are CO₂, CO, TSP, SO_x, and NO_x of which the latter two products are emitted in small amount. Emissions of SO₂ and NO_x are lower than conventional fossil fuels due to

the characteristically low levels of sulfur and nitrogen associated with bagasse. However, if auxiliary fuels are used during startup of the boiler or when the moisture content of the bagasse is too high to support combustion, then SO₂ and NO_x emissions will increase].

Social Concerns

The energy and environmental implications of ethanol production are more important than ever. Much of the analysis and public debate about ethanol has focused on the sign of the net energy of ethanol: whether manufacturing ethanol takes more nonrenewable energy than the resulting fuel provides. It has long been recognized that calculations of net energy are highly sensitive to assumptions about both system boundaries and key parameter values. In addition, net energy calculations ignore vast differences between different types of fossil energy. Moreover, net energy ratios are extremely sensitive to specification and assumptions and can produce un-interpretable values in some important cases.

However, comparing across published studies to evaluate how these assumptions affect outcomes is difficult owing to the use of different units and system boundaries across studies. Finding intuitive and meaningful replacements for net energy as a performance metric would be an advance in our ability to evaluate and set energy policy in this important arena. Evaluations of bio fuel policy should use realistic assumptions (e.g., the inclusion of co-product credits calculated by a displacement method), accurate data, clearly defined future scenarios, and performance metrics relevant to policy goals like reducing greenhouse gas emissions, petroleum inputs, soil erosion and cost of land conversion cost.

3.9 PROJECT BENEFITS

This project of bagasse energy development was a logical extension of Sugar Sector Action Plan wherein Government and the private sector participated in the restructuration process of the sugar industry given that enhanced use of by-products, including bagasse for electricity production was a key objective in the plan. Furthermore, the active participation of the private sector with Government in formulating all the policy measures coupled with appropriate enactments enumerated brought about an improved business environment for the sugar sector

Improvements in the Social Infrastructure

It will not disturb the existing pattern of social relations and democratic set up. The MEL project Proponents are already in this area running their sugar unit over the years. The sugar unit is not only running with efficiency it is running with no disturbance from the local people. Local people have even encouraged the expansion at this same site of sugar production. This is the case for diversification for alcohol. This is mainly because the Proponent is accepted by local culture, without

any disturbance to the existing pattern of social relations or hierarchy. Time management is of importance especially in industrialized community though may not be so in agriculture oriented society. In rural background, much of the time and energy is wasted in reaching from one place to another. This is due to lack of swift mode of transport. By the presence of this industry, number of vehicles in this area is generally improved (both private and public-owned). This is helping in shortening the time reaching destination and utilize it for some fruitful is productive work.

Industry gets raw material from the farmers. Better and purer the raw material quality the better is the finished product of the industry and sophisticated market. Both of them can get better pricing. To maintain this continuity, farmers are getting improved seed from this project proponent because this is based on "Symbiosis", as also timely funds.

The rural economy is found generally dwindling because they depend only on one single source of livelihood namely conventional agriculture. With support of cash-crop by now they have more purchasing power and more use of domestic animals. The increased greenery and farming with support of ready compost, the grass production can increase and animal husbandry will enhance:

Up-lift of rural sector are slow because of lack of amenities and facilities. If there is a nucleus of industry or steady support of money flow, such utilities can come to that area and sustain. Education level goes along with flow of funds and avenue of livelihood. Dependence on Government subsidy also goes along with political stability of the area. The level of education and literacy (especially rural and women) is very poor, needing improvement. The Proponent certainly can play a catalytic role in this activity.

Likewise, the health level goes along with flow of funds and avenue of livelihood. Dependence on Government institutes like PHC (Primary Health Centre) also goes along with political stability of the area. The level of health and medication (especially children and women) is very poor, needing improvement. By the help of proponent it will certainly improve.

Employment Potential – Skilled, Semi-Skilled and Unskilled

The industry and its supporting activity need many types of people right from manual to managerial strength, in a pyramid. The raw material growing may need unskilled workers with people on tractors and tractor repairers as skilled ones. So in manufacturing activity all three types i.e. skilled, semi skilled and unskilled people are required. The overall potential including the garages, loading-unloading actions, eateries, small shop owners is substantial. The local people can get a good share out of this. In the factory, science and technology prevails and there some outsiders engaged at least

for the time being. If the second generation local people acquire that skill, they too will be able to fill the gap and accrue benefit of higher jobs. If the activity of sugar and alcohol manufacturing becomes stable by that time, perhaps expansion may become possible further and then employment availability may further enhance. It can be stated that by this activity employment potential is certainly increasing in all walks of life – skilled, semi-skilled and unskilled. The proponent's management consists of good-meaning people. They have employed proper sons of the soil without discrimination, wherever feasible.

Improvements in the Physical Infrastructure

This Project is helping in improving the physical infrastructure of this area. It will not disturb the existing pattern of drainage, because the building construction is not massive. It is more a steel structure not preventing the natural flow of rain water.

The industry is dependent on raw materials and helping chemicals, which arrives by road. The finished goods too are dispatched by goods. All the labor force will come by road. Road connectivity thus improved. This improved physical infrastructure is an added facility to the community for surface transport.

Greening drive in the premises gives a pleasant look to the land. It absorbs some portion of the CO₂ produced by fuel burning (utilities) as well as created by fermentation (process). For greening fresh water is not used. The treated wastewater will be recycled and its CNPK contents are useful as nutrients. Canopy of trees arrests dust fugitive SPM as well as the noise.

3.10 CONCLUSION

The environmental base line survey and consideration of project parameters, specially bagasse based power generation suggests that the changes to the base line by undertaking the project do not have an overall negative effect as follows. The base line parameters of land usage will not be adversely affected due to setting up of MEL project as the area will be carved out of the existing and adjacent MSML area. In fact it will contribute to effective utilization of land resources at the disposal of the project sponsors. For similar reasons the species birds, mammals and other life forms will not be affected. The plant will open opportunities to the inhabitants of the area to acquire technical skills and employment at the power plant. Through better combustion techniques in the boiler, the bagasse fuel will help in reduction of greenhouse gases. Through treatment of effluents the land and underground water resources will not be polluted. Thus, the project is expected to have an overall positive impact.

TECHNICAL DETAILS & DESIGN OF CO-GENERATION PLANT

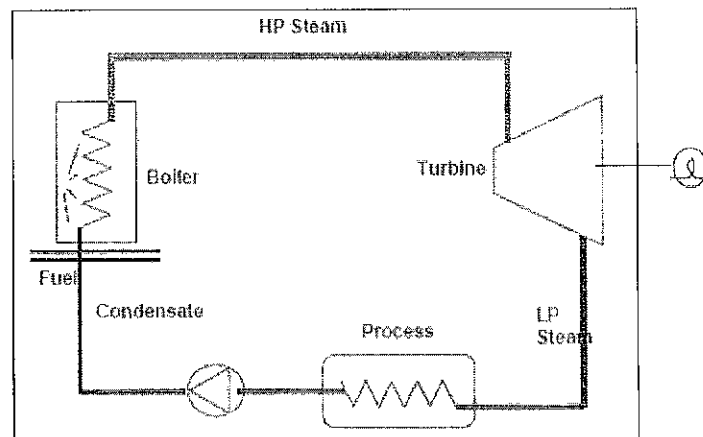
4.1 TECHNICAL ASPECTS

Co-generation based on Rankine Cycle is not new to the sugar industry, however Co-generation based on high pressure boilers and extraction condensing or straight condensing machines are definitely new to the industry. In olden days, the power cycle adopted was based on 14 kg/cm² (g) and 21 kg/cm² (g). This has been gradually increasing to 32 kg/cm² (g), 45 kg/cm² (g), 66 kg/cm² (g), 86 kg/cm² (g), 110 kg/cm² (g) and now stabilized at 124 kg/cm² (g) and 5400C. With the size of the co-generation plant going above 40MW the use of 135 kg/cm² (g) pressure cycles are being explored. The following highlights a few of the technical issues for designing of the co-generation projects.

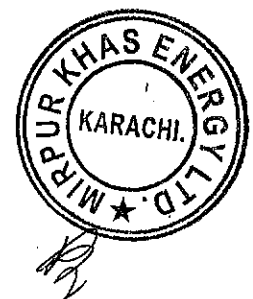
The basic design of the co-generation plant

Basically, the co-generation plant configuration is site specific, even though, even though some amount of standardization could be made for the gross root plants. The scheme should consider the available bagasse, the variation in the bagasse availability. Considering the variation in the bagasse availability and the possible variation in the process steam consumption and the number of days of operation, maybe it is better to go down size of the plant and ensure maximum plant load factors. The plant cycle should be optimized to give best efficiency.

Even though there is no limit to the achievable steam pressure and temperatures with bagasse firing, it is essential a cost benefit study is made before deciding on the steam cycle parameters. In such a study proper consideration should be given to the cost aspect of the higher grade metallurgy of the turbine and the boiler, specifically the super-heater and the piping.



4.1 Back-pressure steam turbine system



Based on priority in utilizing the available energy, electricity or heat, co-generation systems are classified as topping cycle (where priority is for generating electricity) and bottoming cycle (where heat takes priority over electricity).

Topping cycle

The topping cycle is the most commonly used method of co-generation. In this cycle, fuel is used first for producing electricity and then for heat. Steam turbine topping cycles are commonly used in the pulp and paper industry; heat recovery and combined cycle systems are used in many chemical plants; and gas turbine cycles are useful in central heating or cooling systems.

4.2 TECHNOLOGY DESCRIPTION

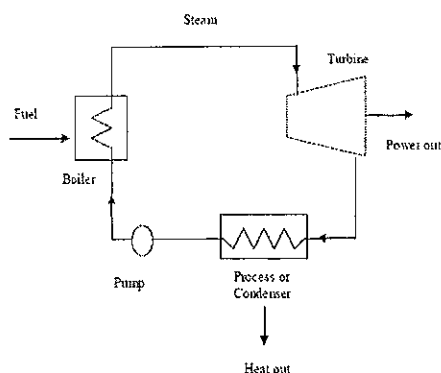
Basic Process

The thermodynamic cycle for the steam turbine is known as the Rankine cycle. This cycle is the basis for conventional power generating stations and consists of a heat source (boiler) that converts water to high pressure steam. In the steam cycle, water is first pumped to elevated pressure, which is medium to high pressure, depending on the size of the unit and the temperature to which the steam is eventually heated. It is then heated to the boiling temperature corresponding to the pressure, boiled (heated from liquid to vapor), and then most frequently super-heated (heated to a temperature above that of boiling).

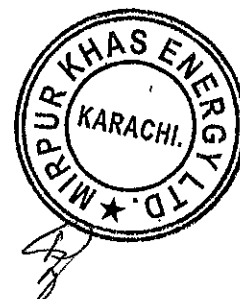
The pressurized steam is expanded to lower pressure in a turbine, then exhausted either to a condenser at vacuum conditions, or into an intermediate temperature steam distribution system that delivers the steam to the industrial or commercial application. The condensate from the condenser or from the industrial steam utilization system is returned to the feed water pump for continuation of the cycle.

Components

A schematic representation of a steam turbine power system is shown below.



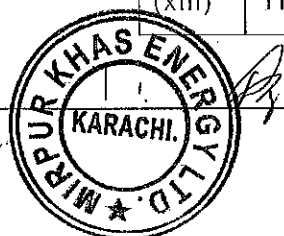
4.2 Boiler / Steam Turbine System



In the simple schematic shown, a fuel boiler produces steam which is expanded in the steam turbine to produce power. When the system is designed for power generation only, such as in a large utility power system, the steam is exhausted from the turbine at the lowest practical pressure, through the use of a water-cooled condenser to extract the maximum amount of energy from the steam.

4.3 MEL PLANT DESCRIPTION

(i)	Plant size installed capacity	26 MW Gross
(ii)	Type of Technology	Cogeneration Plant with high pressure boiler of 110 bar, 540 C class; turbogenerator with extraction steam and condenser, cooling towers and balance of plant
(iii)	Number of Units/Size (MW)	1 x 26MW
(iv)	Fuel	Bagasse except for start up
(iv)	Unit Make/ Model & Year of Manufacture	New boiler, turbo generator, switch gear and BOP
(v)	Commissioning/Commercial Operation date of each Unit of the Generation Facility	Within 20 months from financial Close
(vi)	Expected Useful Life of the each Unit of the eneration Facility from its Commercial Operation/ Commissioning Date	30 years
(vii)	Expected Remaining useful Life of each Unit of the Generation Facility (at the time of grant of (Generation License)	30 years
(viii)	Generation Voltage	11000 Volts
(ix)	Frequency	50 Hz
(x)	Power Factor	0.8
(xi)	Automatic Generation Control (AGC)	Yes
(xii)	Ramping Rate	3.2 Kw/sec
(xiii)	Time required to Synchronize to Grid	4 hours for cold start



4.4 TECHNICAL DETAILS OF PROPOSED CO-GENERATION POWER PLANT

Description	Season	Off- Season
Days	115	75
Gross Capacity (MW)	25.50	26
Auxiliary Consumption (MW)	2.27	2.21
Net Installed capacity (MW)	23.23	23.79
Sugar Mills Consumption (MW)	4.01	0.50
Exportable Capacity to Grid	19.22	23.29

Total Bagasse Generated	MT	292082 Ton
Total Bagasse Consumed	MT	203625.75 Ton
Off-season steam generation	MT	176913 Ton

4.5 Fuel Raw Material Details

(i)	Primary Fuel	Bagasse	
(ii)	Alternate / Backup Fuel	Furnace Oil	
(iii)	Fuel Source (Imported / Indigenous)	Primary Fuel	Alternate / Back-up Fuel
		Bagasse	Furnace Oil
(iv)	Fuel Supplier	From Sugar Mills	From Any oil Supplier
	Supply Arrangement	Primary Fuel	Alternate/ Back- Up Fuel
		Through Conveyor Belts/	Through Loading Tankers and Pumping
(v)	Sugarcane Crushing Capacity	8500 TCD	
(vi)	Bagasse Generation Capacity	2550 Ton/Day	
(vii)	Fuel Storage facilities	Primary Fuel	Alternate/ Back- Up Fuel
		Within Premises Yard	Near Boiler
(viii)	Capacity of Storage Facilities	Primary Fuel	Alternate/ Back- Up Fuel

		130000 Ton	Tank-1	Tank-2	Tank-3	Tank-4
			75 ton	x	x	x
(ix)	Gross Storage Capacity	Primary Fuel	Alternate / Backup Fuel			
		135000 Ton	x			

4.6: Emission Values

Bagasse is the crushed remaining of sugarcane stalks left after the extraction of juice. Normally, it is used as fuel for supplying the energy need of the sugar mills. It is a fuel of varying composition and heating value. Its characteristics depend on the climate, type of soil upon which the cane is grown, variety of cane, harvesting method, amount of cane washing, and the efficiency of the milling plant. Most bagasse has moisture content between 45 and 55% by weight. The carbon in bagasse is part of the global carbon cycle, the CO₂ emission from the combustion of bagasse does not contribute to global warming. Typically, there is low amount of nitrogen (1.82%) and sulphur (<1%) in bagasse and low combustion temperatures contribute to low NO_x and SO₂ formation. Consequently, bagasse can be an environmentally-friendly raw material for power generation and has high potential as an alternate, renewable source of energy.

For a 25 MW class bagasse fired cogeneration plant, the SO₂ and NO₂ are in the range of 11.3 mg/m³ and 11.3 mg/m³. These are far less than the NEQS standards which are given below. The project sponsors have committed to have the specifications of the boiler in line with the bagasse characteristics to meet the NEQS easily

	Primary Fuel	Start up Fuel
(i)	SO _x (mg/Nm ³) as SO ₂	<1700
(ii)	NO _x (mg/Nm ³)	<600
(iii)	CO ₂	12-16
(iv)	CO (mg/Nm ³)	<800
(v)	PM10(mg/Nm ³)	<500

4.7 Cooling System

(i)	Cooling Water Source / Cycle	Canal water + R.O(Treated water)
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ANALYSIS OF ALTERNATIVES

5.1 INTRODUCTION

A project of any nature consists of various activities, which involve men, money and material. These activities may consume natural resources and discharge wastes, which are likely to have serious consequence to the environment. A number of alternative options may be available to carry out many of these activities. An option with least or nil adverse environment impacts is to be selected. Critical analysis is therefore required for selection of the right alternative. Alternative Analysis (AA) has been done for critical aspects of the project. The project will be using ample availability of sugarcane from command area & bagasse (renewable energy source) from nearby sugar unit for generation of power i.e. 23.5MW (net) to supply much needed power to national grid. Displacement of fossil fuel energy production during bagasse use period will also result in net reduction in CO₂ emissions so contributing to the control of climate change. M/s Mirpurkhas Energy Limited) has proposed 23.5 MW power project in the close vicinity of MSML. While selecting this site project Proponent have considered following factors on the basis of which the site was finalized. While setting -up the proposed project following parameters were kept in consideration

Site Alternative

A number of factors related to economical crushing, sugar production, economic power generation, power evacuation and environmental aspects are involved in site selection. The important factors which influence the project site selection are given below:

1. Techno-economic considerations
2. Available infrastructure
3. Environmental considerations

Techno-Economic Considerations

The techno-economic considerations in the selection of a site are as detailed below:

- Availability of suitable land for proposed project
- Availability of facility for receipt of raw materials such as bagasse etc
- Availability of adequate water for process within reasonable distance



- Suitability of land from topography and geological aspects
- No displacement of people.
- Availability of construction water and power

Available Infrastructure

Available Infrastructure considerations in the selection of a site are as detailed below:

- Availability of infrastructure facilities such as main road access to the proposed project site for ease of transportation of workforce, consumables, plant equipment and fuel etc.,
- Facility for interconnection with transmission and distribution systems for evacuation of power,
- Availability of facilities like medical, education, civic amenities and railway station within a reasonable distance from the site.

5.2 ENVIRONMENTAL CONSIDERATION

Environmental considerations critical to the selection of a site are listed below:

- Avoiding the use of forest land
- Minimum use of cultivable land
- Away from thickly populated town
- Minimum requirement of cutting of trees
- No displacement of people
- Away from critically polluted area
- Away from national park and wildlife sanctuaries
- Away from tiger reserve/Elephant reserve/turtle nestling grounds.
- Away from core zone of biosphere reserve.
- Away from Archeological sites.
- Away from defense installations.

As per above site selection criteria the proposed site is most suitable for set-up the plant.

Analysis of Co-Generation

Cogeneration has been adopted as standard means of energy generation since long by the sugar industry. With the use of efficient processing and energy management systems, energy from bagasse, over and above the sugar factory needs, is available and can be exported conveniently in the form of electric power. Application of sugar cogeneration will replace a part of fossil-based electricity generation leading to a more sustainable mix in power generation. Cogeneration with power export will assist in reducing greenhouse gases (GHGs) emissions. In order to be more viable, efficient and

safe operation, the existing steam and power generation system will be closed down and replaced with the more efficient system in proposed power plant.

5.3 ANALYSIS OF ALTERNATIVE

Technology

The only option to use the bagasse effectively is the combustion route, where the bagasse is combusted in a boiler to generate steam. However, because of the nature of and characteristics of bagasse, both atmospheric & circulating fluidized bed technologies (AFBC and CFBC) and the pulverized fuel (PF) combustion technologies are not suitable for the stand-alone combustion of bagasse. Some attempts had been made to integrate the traveling grate or pinhole grate technology with a PF technology, but the applicability of this design for use of standalone bagasse firing, the cost and efficiency are questionable. So, for all practical purposes, the traveling grate technology will be the best suited for this specific application. The traveling grate technology may not be the best for coal, as other technologies like CFBC and PF are best suited for coal, but however, with two totally different types of fuels and with other technologies not suitable for bagasse, a compromise has been made to settle for the travelling grate operating on the Rankine Cycle, with a traveling grate fired boiler and with a turbine which is designed to supply the process steam from its extraction points.

The selection of pressure and temperature, at which high pressure steam is generated, will have a significant influence on the amount of power generation. At higher pressure and temperature the boiler efficiency improves and the same quantity of fuel generates the high pressure and temperature, containing additional thermal energy. It therefore follows, that the highest practical steam pressure and temperature should be selected, taking into consideration the limitations imposed by expensive materials of construction for boiler, turbine and piping, as well as the limitations of quality and treatment of boiler feed water. At the same time, the capital and operating costs also impact the selection of steam pressure and temperature parameters.

Analysis of Boiler Technology

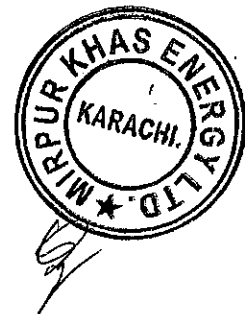
The proposed project has envisaged 110 bar pressure and 525°C temperature parameters for steam, which will give optimum efficiency and power generation, when extracted through a matching turbo generator set. The capacity of the boiler and turbine will be 135 TPH and 26.00 MW respectively. The design philosophy will be to generate optimum levels of power from high pressure steam, supply steam and power requirements of the sugar complex and auxiliaries, and export optimum level of power to nearby substation.

For bagasse firing, traveling grate or dumping grate boilers are utilized. In traveling grate the ash discharge is by grate movement and automatic. In dumping grate the ash has to be removed manually

with opening of furnace bottom doors which is not recommended in high pressure boilers. Hence the selection of traveling grates

Conclusion

From the above discussion and analysis, the following is evident. Bagasse as a fuel for the project is the best choice both from the point of view of its availability from adjacent sugar mill but also due to environmental consideration as its emission are far less than what they would have been if the sponsors would have gone for fossil fired power plant. Thus the project's proposal for using bagasse, is the best option.



ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 INTRODUCTION

The bagasse generated as by-product in the sugar mill will be burnt as fuel in the power plant. The steam produced by burning the bagasse in the boilers will produce electricity in return and will also meet the process steam requirement of the sugar mill and the electric power will be exported to the national grid.

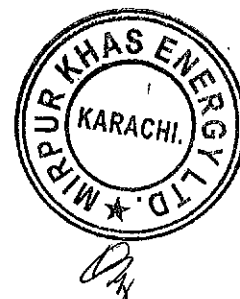
The proposed project involves power generation process and equipment. Project process and equipment involved are boilers, steam turbines, generators, cooling towers, biomass storage and handling facility, Furnace oil storage and handling facility, and grid-station

Travelling grate boiler technology has been planned which is globally proven for efficient use of biomass as fuel for boilers. Since this technology primarily uses biomass fuel such as bagasse and cotton stalks, hence it is environmentally, economically and technically sound. Baseline of the area's environmental and socio-economic settings was collected in a way like what are water resources, what is quality of water, climate, ambient air and noise

The Jamrao canal is the principal surface water resource in the project area. The Jamrao canal is located about 3.5 Km on east side of the project site which is major source of irrigation. canal water is the major source of drinking water & irrigation in the area.

Climate of Mirpurkhas district is extremely hot in summer and cold in winter. The summer from April to September is very hot (temperature rises to 49 °C). The winter from mid-November to end of January is sufficiently cold (temperature drops to - 8°C).. The spring commences from early February and continues till mid of April. When the temperature starts raising rapidly, the monsoon usually break during July and August, when moderate showers of rain are received.

Wind



The average daily wind speed in June has been around 31 km/h, that's the equivalent to about 20 mph, or 17 knots. In recent years the maximum sustained wind speed has reached 93 km/h, that's the equivalent of around 58 mph, or 50 knots.

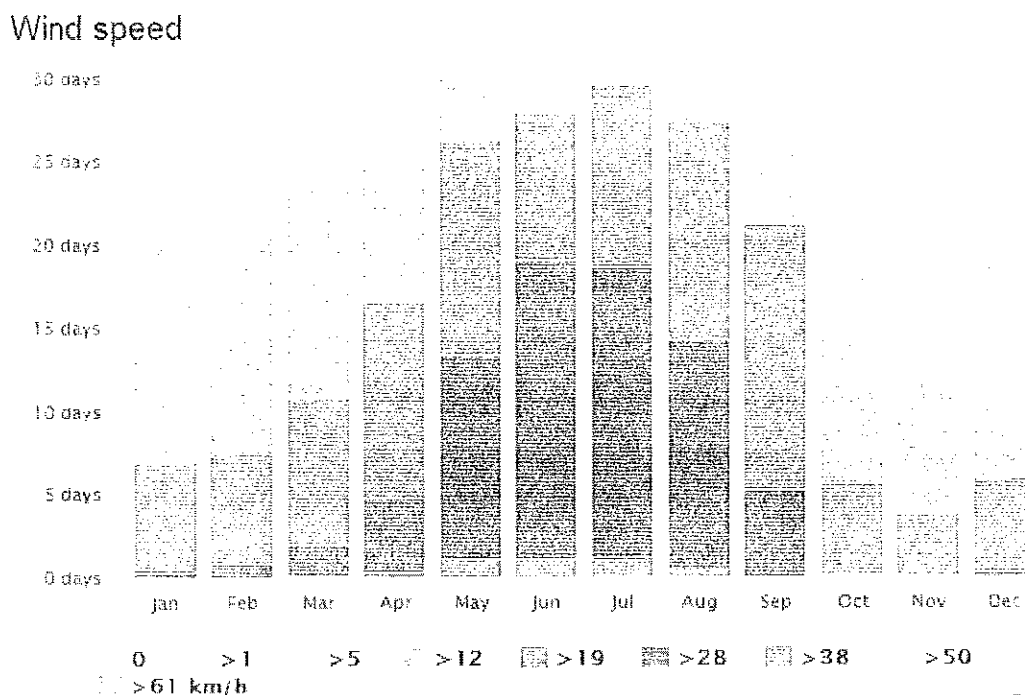


Fig 6.1: Wind Speed data of Mirpurkhas

The diagram for Mirpur Khas shows how many days within one month can be expected to reach certain wind speeds. Monsoons create steady strong winds on the Tibetan Plateau from December to April, but calm winds from June to October.

The wind rose for Mirpurkhas shows how many hours per year the wind blows from the indicated direction. Example SW: Wind is blowing from South-West (SW) to North-East (NE). Cape Horn, the southernmost land point of South America, has a characteristic strong west-wind, which makes crossings from East to West very difficult especially for sailing boats. The potential existing sources of air pollution in the project area are road traffic, few industries, brick kilns, farm machines, and agricultural activities.

There is no continuous major source of noise in the project area. Intermittent sources include farm tractors, farm equipment, and road traffic. Considering the intermittent nature of these noise sources, it can be concluded that the noise pollution in the area is low.

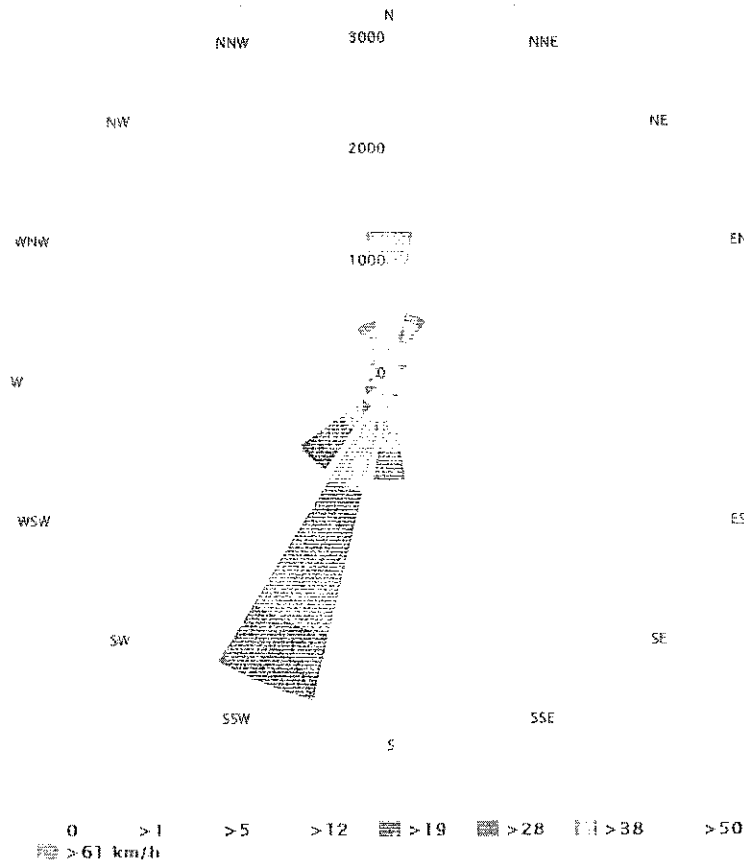
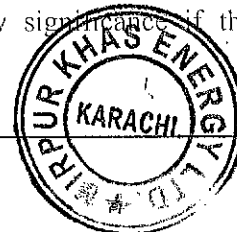
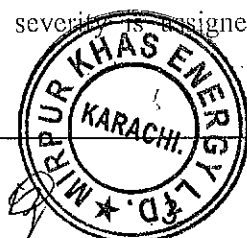


Fig 6.2: Wind Rose presenting wind direction of Mirpurkhas

The potential impacts of the project are identified by desktop screening exercise, using checklist during field visits for collection of baseline data, professional judgment, published literature on environmental impact of similar projects and standard environmental guidelines. A critical step in identifying potential impacts is discussed with project proponent, consultation with stakeholders and community to identify their concern. The main aspects associated with potential impacts are geomorphology, water resources (aquifer and surface water quality), ambient air quality, waste discharges, noise pollution, greenhouse gases emissions, ozone depleting substance, protected areas, ecology of the area, including flora and fauna, vehicle movement, socio-economic conditions, and archaeology.

The potential impacts are classified according to the type of potential receptors. The impacts have been assessed by following standard international guidelines and best available practices. The method defines three levels of consequence (or severity) and likelihood (or probability of occurrence) - high, medium or low, - of an impact. A standard risk based approach has been used in which the significance of an impact is determined on the basis of the level of consequence and likelihood of the impact e.g. an impact of medium severity is assigned a low significance if the likelihood of



occurrence of the impact is low and high significance if the likelihood of occurrence is high or almost certain.

The identified environmental and socio-economic impacts associated with the proposed project construction activities are evaluated in detail. Construction activities here mean construction of campsite, platform and fabrication of plant. The impact assessment of construction activities are discussed in detailed in Table 6.1.

Impacts associated with operation activities are air emission, water resources, GHG emissions, hazardous materials, ozone depletion, plant noise, wastewater and solid waste management

6.2 AIR EMISSIONS

Potential impacts: impacts on local air quality may arise from biomass, particulate matter emissions results from unburned carbon and impurities in fuels Likely impacts of these activities may include deterioration of local and regional air quality, respiratory diseases in local community, global warming and acid precipitation.

Assessment of potential impacts

Power plant air emissions may have a major impact on the local and regional air quality. A significant impact will be interpreted if the concentration of pollutants in the ambient air exceeds the SEQS or recognized international guidelines for ambient air quality such as World Bank and World Health Organization (WHO) ambient air quality guidelines.

Mitigation measures

The proposed mitigation measures to reduce the impacts on air quality during the proposed operation activities are either use of cleaner fuels (low sulfur) or for each boiler, dust emission (particulate matter will be ensured by an electrostatic precipitator.

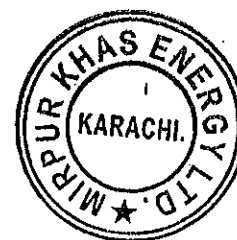
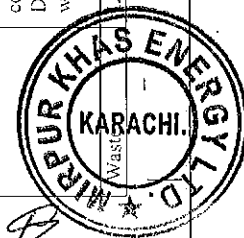



Table 6.1: Impact Assessment of Construction Activities of power generation unit

Environmental aspects	Potential Impact	Description	Consequence severity rating	Likelihood / Frequency	Nature of impact	Geographical location of Impact	Duration of Impact	Reversibility of Impact	Significance of Impact
Protected Areas	Habitat loss, temporary relocation	No protected areas, wetlands or wildlife sanctuary were found inside or in the close proximity of the area.	Low	Low	No impact	Not applicable	Not applicable	Not applicable	Low
Geology and Soils	Soil erosion, soil contamination by the spillage of fuel, oil and chemicals	The construction activity will involve a little bit clearing of land for the purpose of installation of power plant units. The land is already acquired by proponent and in use as yard. During construction and fabrication activity, there is the potential for spills of fuel, lubricating oils and chemicals that could lead to soil contamination.	Medium	Medium	Direct	Local /Regional	Short Term	Reversible	Medium
Water Resources	Depletion of aquifer from overuse, and contamination of water resources by the spillage of fuel, oil and chemicals	The fresh water is available at 5-8 m depth, so proposed project activities will not impact on local water resources. Surface and aquifer quality may deteriorate if pollutants are mixed with Surface runoff during rain and carried to water resources in the vicinity, or if pollutants leach into the ground.	Medium	Low	Direct	Local /Regional	Short Term	Reversible (depending on the rainfall pattern and aquifer recharge).	Low
Air Quality	Vehicular emission. Dust emission	Construction and fabrication of plant activities can generate locally exhaust emission and dust during activities such as 'earthmoving' operations by using tower cranes, bulldozer- and other pollutants emission from diesel generators and vehicles.	Medium	Low	Direct	Local/ Regional	Short Term	Irreversible	Low
	GHG Emissions	The main source for GHG emissions will be generators and vehicles.	Low	Low	Indirect	National	Long term	Irreversible	Low
	Ozone Depletion	HCFC and CFC's if any of them used during project activities, can deplete ozone layer	Low	Low	Indirect	National	Long term	Irreversible	Low
Noise	Impacts at nearest community. Disturbance to the wildlife	There is a potential of disturbance to nearby community due to noise. There is also potential of wildlife temporary relocation because of noise.	Medium	Low	Indirect	Local	Short term	Reversibility	Low
	Liquid Waste:	The proposed project activity would generate liquid	Medium	Low	Direct	local	Short term	Reversible	Low



The map shows the northern Adriatic coastline of Italy. Key locations marked include Trieste, Udine, and Gorizia. Sampling stations are indicated by numbers 1 through 10. The map includes latitude and longitude coordinates and labels for various locations such as Trieste, Udine, and Gorizia.



Permissible limits of NO_x will be ensured by boiler design (to limit NO_x generation). Monitoring of ambient air parameters (PM₁₀, SO₂, and NO_x) emissions should be carried out to ensure compliance with the SEQS as per requirement of SMART.

Residual impact

If the mitigation measures are effectively implemented, the residual impact of the proposed activities on the area's air quality is expected to be low in significance.

6.3 WATER RESOURCES POTENTIAL IMPACTS

Proposed activities could affect the area's water resources in two ways by overuse and contamination.

Assessment of potential impacts: Water will be required during operational activities. Water will be exploited from groundwater aquifer through deep bore wells. Water conservation practices will be utilized to reduce the water consumption. The domestic effluents shall be collected and treated through on site wastewater treatment system including septic tanks. Process effluents will be collected and treated in a separate network to comply with SEQS.

The project area may expect heavy rain and to protect the area from this impact, campsite location will be selected on relatively high ground. All spills will be handled as soon as reasonably practical.

Mitigation measures: Follow good housekeeping practices with all machinery that may potentially discharge wastewater. No untreated effluents will be released to the environment.

Residual impact

The nature of impact is direct and its reversibility depends on the rainfall pattern, catchment size and associated aquifer recharge to the project area. The significance level given is low, because the water in the area is abundant due to the project area's proximity to the Indus River. Proper implementation of the required mitigation and monitoring techniques will prevent any adverse water quality impacts.

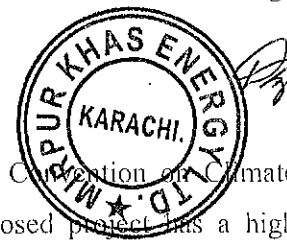
6.4 GHG EMISSIONS

Potential Impacts

Greenhouse gases are released as a result of combustion process. The increase in greenhouse gas emissions in the atmosphere due to human activities such as combustion and land use change contributes to the global warming.

Assessment of potential impacts

The Kyoto Protocol is an amendment to the United Nations Framework Convention on Climate Change (UNFCCC) an international treaty on global warming. The proposed project has a high



thermal efficiency relative to alternative systems and will produce lower CO₂ emissions per kilowatt of electric generation produced. Greenhouse gas mitigation options include sequestration of CO₂ in biologic 'sinks' such as plant biomass. Proponent committed to plant 20,000 trees along roads, boundary walls and in orchards.

Mitigation measures

There are no generally accepted methods for the mitigation of CO₂ emissions. However, one possible mitigation strategies will be given consideration. This includes carbon sequestration by planting trees. As the plant site is in the area with an average rainfall of 212 mm on the basis of last 10 years data, carbon sequestration by planting indigenous trees near the plant site could be viable remedial measure.

Residual impacts

CO₂ emissions contributes to the global warming however, CO₂ emissions from the proposed project will be considerably less per unit electricity generated compared to any other conventional alternative.

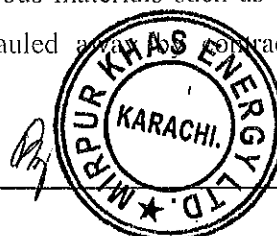
Hazardous materials potential issues: The operations of power plant will require use of process chemicals for water treatment, lubrications and corrosion control etc. Some of these chemicals may be of hazardous nature. These chemicals may have a potential to harm human health and contaminate soil, surface and groundwater if not handled correctly.

Assessment of potential impacts

A significant impact will be interpreted if the hazardous materials are not handled properly. The chemicals for the plant operations will include various salts, coagulants, flocculants, sulfuric acid and caustic soda for water treatment and regeneration systems, lubricants etc. for use in plant maintenance and workshop.

Mitigation measures

A chemical and hazardous material handling procedure will be prepared that will contain storage and handling of hazardous materials will be in accordance with international standards and appropriate to their hazard characteristics, storage areas for fuels and liquid chemicals will be designed with secondary containment to prevent spills and contamination of soil and groundwater. Labeling will be placed on all storage vessels/containers as appropriate to national and international standards. The labeling will clearly identify the stored materials. Supporting information such as material safety data sheets (MSDS) will be available for all hazardous materials. Hazardous materials such as used oil filters, batteries, chemical containers, grease traps etc. will be hauled away by contractor for recycling.



Residual impacts

Implementation of the proposed mitigation measures is not likely to leave any significant impact. The proposed project will avoid use of ozone depleting compounds such as Halon, Chlorofluorocarbons (CFC), Hydro chlorofluorocarbons (HCFC) or any other source which deplete the ozone layer, so the overall assessment of the impact is significantly low.

6.5 PLANT NOISE POTENTIAL ISSUES

The proposed power plant extension will result in increase in noise. The increased noise may be a source of disturbance to nearby communities and residential areas.

Assessment of potential impacts

Noise sources in the community mostly intermittent in nature including road traffic. It can therefore be concluded that area surrounding the power plant boundary has low noise pollution. Noise levels at the power plant location will be high, however only concerned staff will be working in the area with required PPE, and the exposure will be limited to short durations. The residential area is located about 2 Km away from the proposed project site and there will be no significant impact on community. Plantation along the boundary walls of plant will also act as noise barrier and will prevent the noise pollution.

Mitigation measures

Effective noise suppression design and plan will be made for all noise producing equipment. Plantation will be developed along boundary side of plant site.

Residual Impacts

Implementation of the mitigation measures proposed above will result in negligible / no residual impact due to plant noise on surrounding environment.

6.6 WASTEWATER POTENTIAL ISSUES

The power plant operation will generate wastewater in the form of cooling tower blow down, plant low volume wastes and sanitary wastewater from plant colony. The wastewater may be a potential source of pollution to surface and groundwater resources of the area.

Assessment of potential impacts: A significant impact will be interpreted if discharged to the environment exceed the SEQS limits for effluent discharge or World Bank guidelines for effluent discharge from power plant. Similarly a significant impact will be interpreted if wastewater contaminates the groundwater. The wastewater will be treated by using an appropriate treatment technology before discharging into open environment. Treated effluents will comply with SEQS.

Mitigation measures

Wastewater will be treated before discharging into nearby drain canal. Monitoring of effluents should be carried out as per requirement of SMART to ensure compliance with the SEQS and World Bank guidelines.

Residual impacts

Implementation of the proposed mitigation measures and regular monitoring is not likely to leave any significant impact of the wastewater from the proposed power plant.

6.7 SOLID WASTE MANAGEMENT POTENTIAL ISSUES

The solid waste generated during the operational phase of proposed project may pose health hazard, pollute soil, surface and ground water if not managed properly.

Assessment of potential impacts

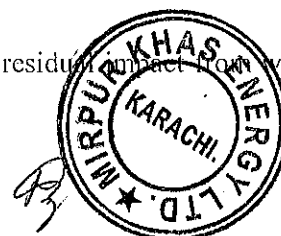
A significant impact will be interpreted if the waste management is not carried out properly; which may effect to health of workers, pollution of soil, surface or groundwater. Any person is exposed to potentially hazardous waste generated by the project. Excessive wastes are generated, recyclable waste is not recycled, waste are scattered, handling of wastes results in contamination, and wastes are improperly disposed of causing pollution. All wastes generated from the project will be properly handled, stored and disposed of. The environmental impacts will be tiniest after the implementation of the proposed mitigations.

Mitigation measures

It includes separate waste bins will be placed for different type of wastes - plastic, paper, metal, glass, wood, and cotton. Recyclable material will be separated at source and hauled away by contractor for recycling, Non-hazardous non-recyclable wastes such as construction camp kitchen wastes will be properly dispose off. No hazardous such as organic waste (fruit and vegetable etc.) waste will be dumped at any location outside the plant boundary. All hazardous waste will be separated from other wastes. Hazardous wastes will be stored in designated areas with restricted access and proper marking. Surplus materials including partially filled chemical and paint containers will be returned to suppliers. Inert wastes will be disposed of onsite as fill material. Training will be provided to personnel for identification, segregation, and management of waste.

Residual Impacts:

Proper implementation of the mitigation measures will ensure that the residual impact from waste is minimum.



ENVIRONMENTAL MANAGEMENT PLAN

7.1 PREFACE

The potential environmental impacts are identified from the planning stage of proposed project through Environmental Impact Assessment process.

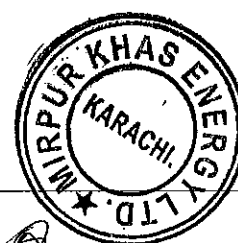
The Environmental Management Plan (EMP) is a tool that serves as to manage environmental impacts and specifically focuses on implementation of mitigation measures in its true sense against likely environmental impacts.

The primary objectives of the EMP are to facilitate the implementation of the identified mitigation measures. It defines legislative requirements, guidelines and best industry practices that apply to the project and the responsibilities of the project proponent. It also defines a monitoring mechanism and identifies monitoring parameters in order to ensure the complete implementation of all mitigation measures and the effectiveness of mitigation measures. It provides the requirements for environmental monitoring and auditing and mechanism for taking timely action in the face of unanticipated environmental situations. The management and monitoring plan is attached in Table 7.1 Table 2.

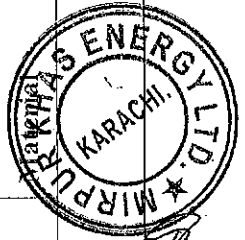
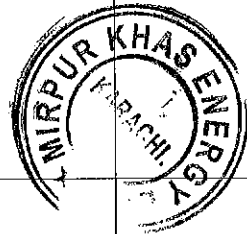


Table 7.1: Potential Impacts and their mitigation measures

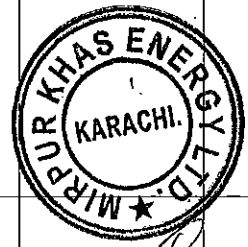
No	Impact	Mitigation Measures	Responsibility	Monitoring	Timing
1.	Air Emissions	1.1 Monitoring of gaseous emissions should be carried out regularly to ensure compliance with the NEQS and World Bank emission guidelines.	MEL	Records of operational parameters / periodic monitoring of stack emissions	Operation phase
2.	Water Resources	2.1 Follow good housekeeping practices with all machinery that may potentially discharge wastewater;	MEL		
3.	Waste Water	4.1 Wastewater will be disposed off after required treatment.	MEL	Provision of wastewater treatment plant at design phase/ Monitor compliance	Operation phase
		4.2 Sanitary wastewater will be treated as per waste management plan	MEL	Monitor compliance /wastewater sampling and testing records	Operation phase
		4.3 Monitoring of effluents should be carried out as per requirement of SMART to ensure compliance with the SEQS and World Bank guidelines.	MEL	Monitor compliance /wastewater sampling and testing records	Operation phase



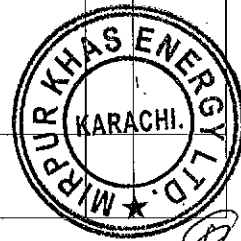
	4.4	No hazardous untreated effluents will be released to the environment	MEL	Monitor compliance	Operation phase
4. Waste Management	5.1	Separate waste bins will be placed for different type of wastes - plastic, paper, metal, glass, wood, and cotton	MEL	Monitor compliance Operation phase	Operation phase
	5.2	Recyclable material will be separated at source.	MEL	Monitor Compliance	Operation phase
	5.3	Non-hazardous non-recyclable wastes such as construction camp kitchen wastes will be disposed off on designated site.	MEL	Monitor Compliance	Operation phase
	5.4	No waste will be dumped at any location outside the plant boundary.	MEL	Monitor compliance	Operation phase
	5.5	All hazardous waste will be separated from other wastes. Hazardous wastes will be stored in designated areas with restricted access and proper marking.	MEL	Monitor compliance	Operation phase
	5.6	An emergency response plan will be developed for the hazardous waste (and substances).	MEL	Develop and implement emergency response plan.	During construction phase
	5.7	All containers of hazardous waste will be appropriately labeled.	MEL	Check compliance	During construction phase
5. Hazardous	6.1	Storage and handling of hazardous materials will be in accordance with international standards and appropriate to their hazard	MEL	Monitor compliance	Operation phase



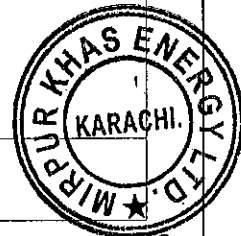
		characteristics			
	6.2	Storage areas for fuels and liquid chemicals will be designed with secondary containment to prevent spills and contamination of soil and groundwater.	MEL	Monitor compliance	Planning and design phase/Operation phase
	6.3	Labeling will be placed on all storage vessels/containers as appropriate to national and international standards. The labeling will clearly identify the stored materials.	MEL	Monitor compliance	Operation phase
	6.4	A Hazardous Materials Register will be in place to cover hazardous material name, HAZCHEM/United Nations Code, Material Safety Data Sheet (MSDS), summary of maximum inventory, storage requirements and precautions, location, physical properties of the materials and approved disposal methods.	MEL	Monitor compliance /Disposal records	Operation phase
6.	Occupational Health & Safety	Electrical Hazards			
	7.1				
	7.1.1	Written procedures to de-energize circuits that will be impacted by the repair activity will be prepared.	MEL	Monitor compliance	Operation phase
	7.2	Confined Space Entry			
	7.2.1	Standard procedures for confined space entries will be prepared. The procedure will include: electrical lockout, air testing before and during entry, proper respiratory protection if required, standby help (buddy system), and piping system disconnection.	MEL	Monitor compliance	Operation phase
	7.3	Machine Guarding			



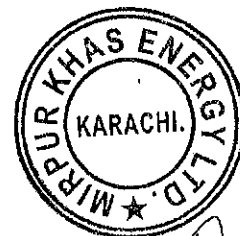
	7.3.1	Proper machine guarding, which is critical for the prevention of injuries to workers by isolating them from moving machinery, will be provided.	MEL	Monitor compliance	Planning and design phase
	7.4	Eye Head and Foot Protection			
	7.4.1	Head protection will be worn in appropriate plant areas, i.e., power block and production areas. Open-toed shoes will be prohibited. Eye protection will be required during all maintenance activities involving dust exposure or the production of particulates from sanding or grinding activities.	MEL	Monitor compliance	Operation phase
	7.5	Fire and Explosion Hazards			
	7.5.1	Firefighting equipment will be available in the form of ABC fire extinguishers as a minimum, and their locations will be clearly marked.	MEL	Monitor compliance	Operation phase
	7.5.2	Exits from work places will be well marked and visible in dim light.	MEL	Monitor compliance	Planning and design phase
	7.5.3	Fire water will be located throughout the plant in well-marked piping.	MEL	Monitor compliance	Planning and design phase
	7.5.4	An emergency response plan will be prepared for evacuation of personnel and equipment.	MEL	Emergency response plan, record of drills	Operation phase
	7.6	Housekeeping			
	7.6.1	Housekeeping will be frequent and thorough to prevent slips, trips, and falls.	MEL	Monitor compliance	Operation phase



7.6.2	A lockout / tag out program will be implemented.	MEL	Records of lockout/tag out	Operation phase
7.7	Chemical Exposure			
7.7.1	Proper precautions will be taken to minimize employee risk to chemical exposure	MEL	Records of occupational air monitoring.	Operation phase
7.7.2	Provision will be made for respirator usage in areas where chemical exposure concentrations are exceeding the guideline values.	MEL	Monitor compliance	Operation phase
7.8	Noise Level Exposure			
7.8.1	Provision will be made for PPEs in areas with noise levels exceeding the guideline values.	MEL	Monitor compliance	Operation phase
7.8.2	A hearing conservation programme for plant workers will be started which may include: audiometry, training in the use of hearing protection (ear muffs, plugs, canal caps), identification of areas that have high (85 dB (A) or above) sound levels, and discussion of the effects of noise exposure	MEL	Monitor compliance	Operation phase
7.8	Noise Level Exposure			
7.8.1	Provision will be made for PPEs in areas with noise levels exceeding the guideline values.	MEL	Monitor compliance	Operation phase
7.8.2	A hearing conservation programme for plant workers will be started which may include: audiometry, training in the use of hearing protection (ear muffs, plugs, canal caps), identification of areas that have high (85 dB (A) or above) sound levels, and discussion of the effects of noise exposure.	MEL	Monitor compliance	Operation phase



	7.9	Heat Related Stress/Illness		
	7.9.1	Staff will be trained for management of heat related stress and illness, such as proper work/rest cycle and increased intake of fluids during hot weather.	MEL	Monitor compliance
				Operation phase



7.2 BOILER EMISSIONS CONTROL OPTIONS - NO_x

NO_x control has been a focus of emission control research and development in boilers. The following provides a description of the most prominent emission control approaches.

Combustion Process emissions Control

Combustion control techniques are less costly than post-combustion control methods and are often used on industrial boilers for NO_x control. Control of combustion temperature has been the principal focus of combustion process control in boilers. Combustion control requires tradeoffs – high temperatures favor complete burn up of the fuel and low residual hydrocarbons and CO, but promote NO_x formation. Very lean combustion dilutes the combustion process and reduces combustion temperatures and NO_x formation, and allows a higher compression ratio or peak firing pressures resulting in higher efficiency. However, if the mixture is too lean, misfiring and incomplete combustion occurs, increasing CO and VOC emissions.

Flue Gas Recirculation (FGR)

FGR is the most effective technique for reducing NO_x emissions from industrial boilers with inputs below 100 MMBtu/hr. With FGR, a portion of the relatively cool boiler exhaust gases re-enter the combustion process, reducing the flame temperature and associated thermal NO_x formation. It is the most popular and effective NO_x reduction method for fire tube and water tube boilers, and many applications can rely solely on FGR to meet environmental standards.

External FGR employs a fan to re-circulate the flue gases into the flame, with external piping carrying the gases from the stack to the burner. A valve responding to boiler input controls the recirculation rate. Induced FGR relies on the combustion air fan for flue gas recirculation. A portion of the gases travel via duct work or move internally to the air fan where they are pre mixed with combustion air and introduced into the flame through the burner. Induced FGR in newer designs utilize an integral design that is relatively uncomplicated and reliable.

The physical limit to NO_x reduction via FGR is 80 percent in natural gas-fired boilers and 25 percent for standard fuel oils.

Low Excess Air Firing (LAE)

Boilers are fired with excess air to ensure complete combustion. However, excess air levels greater than 45 percent can result in increased NO_x formation, because the excess nitrogen and oxygen in the combustion air entering the flame combine to form thermal NO_x. Providing less excess air means limiting the amount of excess air that enters the combustion process, thus limiting the amount of extra

nitrogen and oxygen entering the flame. This is accomplished through burner design modification and is optimized through the use of oxygen trim controls.

LAE typically results in overall NO_x reductions of 5 to 10 percent when firing with natural gas, and is suitable for most boilers.

Burner Modifications

By modifying the design of standard burners to create a larger flame, lower flame temperatures and lower thermal NO_x formation can be achieved, resulting in lower overall NO_x emissions. While most boiler types and sizes can accommodate burner modifications, it is most effective for boilers firing natural gas and distillate fuel oils, with little effectiveness in heavy oil-fired boilers. Also, burner modifications must be complemented with other NO_x reduction methods, such as flue gas recirculation, to comply with the more stringent environmental regulations. Achieving low NO_x levels (30 ppm) through burner modification alone can adversely impact boiler operating parameters such as turndown, capacity, CO levels, and efficiency.

Water/Steam Injection

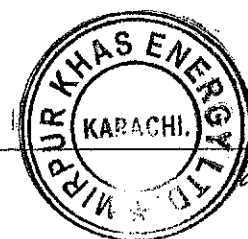
Injecting water or steam into the flame reduces flame temperature, lowering thermal NO_x formation and overall NO_x emissions. However, under normal operating conditions, water/steam injection can lower boiler efficiency by 3 to 10 percent. Also, there is a practical limit to the amount that can be injected without causing condensation-related problems. This method is often employed in conjunction with other NO_x control techniques such as burner modifications or flue gas recirculation. When used with natural gas-fired boilers, water/steam injection can result in NO_x reduction of up to 80 percent, with lower reductions achievable in oil-fired boilers.

7.3 POST-COMBUSTION EMISSIONS CONTROL

There are several types of exhaust gas treatment processes that are applicable to industrial boilers.

Selective Non-Catalytic Reduction (SNCR)

In a boiler with SNCR, a NO_x reducing agent such as ammonia or urea is injected into the boiler exhaust gases at a temperature in the 1,400 to 1,600° F range. The agent breaks down the NO_x in the exhaust gases into water and atmospheric nitrogen (N₂). While SNCR can reduce boiler NO_x emissions by up to 70 percent, it is very difficult to apply this technology to industrial boilers that modulate or cycle frequently because the agent must be introduced at a specific flue gas temperature in order to perform properly. Also, the location of the exhaust gases at the necessary temperature is constantly changing in a cycling boiler.



Selective Catalytic Reduction (SCR)

This technology involves the injection of the reducing agent into the boiler exhaust gas in the presence of a catalyst. The catalyst allows the reducing agent to operate at lower exhaust temperatures than SNCR, in the 500 to 1,200° F depending on the type of catalyst. NO_x reductions of up to 90 percent are achievable with SCR. The two agents used commercially are ammonia (NH₃ in anhydrous liquid form or aqueous solution) and aqueous urea. Urea decomposes in the hot exhaust gas and SCR reactor, releasing ammonia. Approximately 0.9 to 1.0 moles of ammonia is required per mole of NO_x at the SCR reactor inlet in order to achieve an 80 to 90 percent NO_x reduction.

SCR is however costly to use and can only occasionally be justified on boilers with inputs of less than 100 MMBtu/hr. SCR requires on-site storage of ammonia, a hazardous chemical. In addition, ammonia can “slip” through the process unreacted, contributing to environmental and health concerns.

7.4 BOILER EMISSIONS CONTROL OPTIONS – SO_x

The traditional method for controlling SO_x emissions is dispersion via a tall stack to limit ground level emissions. The more stringent SO_x emissions requirements in force today demand the use of reduction methods as well. These include use of low sulfur fuel, desulfurizing fuel, and flue gas desulfurization (FGD). Desulfurization of fuel, such as in FGD, primarily applies to coal, and is principally used for utility boiler emissions control. Use of low sulfur fuels is the most cost effective SO_x control method for industrial boilers, as it does not require installation and maintenance of special equipment.

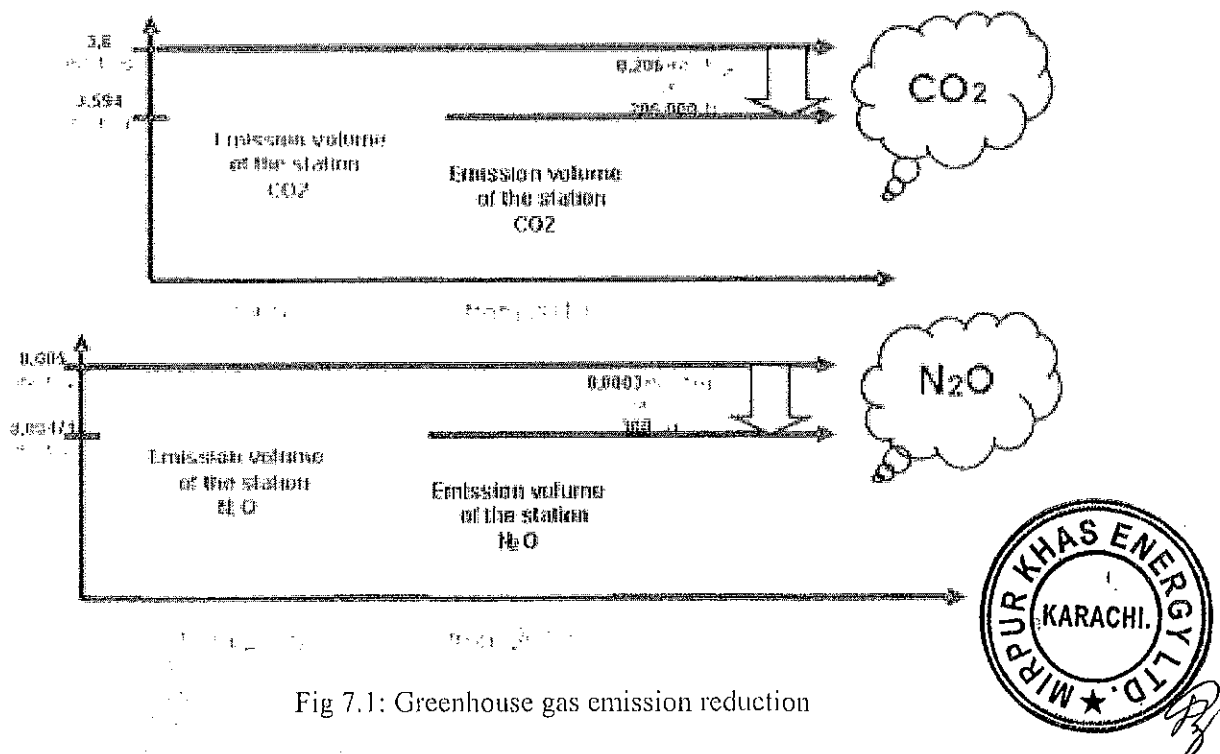


Fig 7.1: Greenhouse gas emission reduction

7.5 KINDS OF IMPACT EXERCISED

Potential project impacts which are provided for the consideration within the investigation of scale identification and the composition of impacts on the environment include the next aspects:

Air quality: The investigation on modeling the dispersion pollutants in the atmospheric air was carried out with the purpose of the assessment of the supposed emission levels.

The basic question, which would be considered within the framework of this investigation, will be an identification of the levels of possible pollutant impacts on the atmospheric air condition at the boundary of the estimated sanitary protection zone of the enterprise.

Waste: The organization scheme assessment of waste management with the purpose of providing the maximum reduction of the impact level connecting with generation and disposal of wastes.

Energy resources and greenhouse gas emissions: The questions connecting with energy resources consumption and generation of greenhouse gas emissions.

Acoustic regime: The noise impact assessment connecting with the object operation, in the context of the existing regulatory requirements.

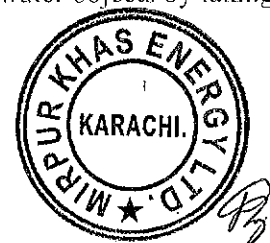
Social factors: The questions of population employment, labor conditions and the proposed object impacts connecting with it.

Soil cover: The investigation of the project impacts on the soil condition determines the possibility for mechanical breaking of the soil condition in the course of the construction, as well as for the threat of polluting by the object operation.

Vegetable cover: General characteristic of the vegetation, typical to this area (the realization of the project will not lead to the change of vegetable cover of this area, as there is no vegetation on the site).

Fauna: The characteristic of the fauna in this area and the assessment of the object impact on the wildlife habitual area.

Surface-water: The assessment of the projected object impacts on the surface-water objects by taking out them for the production needs.



Geological environment and groundwater: The investigation of the projected activity efficiency intended for the prevention of leakages and occurrence of erosion, karstic and other things on the pipeline routes.

7.6 IMPACT AT THE CONSTRUCTION STAGE

The main impact at the stage of construction will be bound to dusting in the course of the construction work. However, with taking into consideration the fact that the nearest dwelling houses are situated at the distance of 680 m, the main type of risk is the dust emission impact on the health of the manufacturing personnel, working at the site. In order to decrease this impacts the activities on dust emission control and its exclusion will be implemented together with the measures that guarantee the permanent usage of the respective personal protective equipment.

As a result of the estimation of transport emissions it was established that the degree of automobile exhaust gas impacts is insignificant.

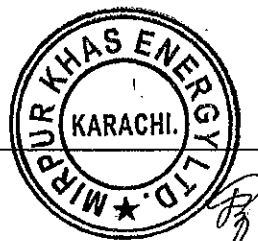
- Pollutants emissions into the atmosphere in the course of the construction will not influence on the health of the residents living near project area and, as a result of providing the protective measures, on the health of the personnel.

Groundwater pollution at the construction site may turn out to take place under the migration of the existing polluting compounds presenting in the earth or/and as a result of the entrance of the materials used in the course of the construction work.

The reduction of the risk degree will provided by means of cleaning the extremely polluted grounds in the proportion to their identification with the subsequent disposal of the extracted polluted earth at the specially equipped areas for dangerous waste disposal outside the enterprise territory. In order to reduce the risk of polluting as a result of spillage and leakage the storage of potentially dangerous materials will be provided in the special containers.

The stipulated control system of dangerous substances storage and the liquidation of pollutants entrance into the soil will make it possible to avoid polluting groundwater by the construction.

The extraction of the old construction elements: underground communication, basement parts, polluted and techno-genic soil will lead to the earth de-compaction and the loss of groundwater protection. The minimization of these negative impacts is possible at the expense of the construction term acceleration and the observation of the recommendations from the EIA section, excluding the entrance of pollutants into the open trenches and pits.



The over site excavation is evidently projected as the minimum one. Significant impacts on the geological environment ought not to be expected within such conditions.

Driving pits under the buildings and engineering constructions determines the most significant impacts on the geological environment. The depth and the size of these pits are designed in such a way that almost the whole thickness of the aeration zone rocks will be blocked by the underground part of the constructions. Therewith a rather weak de-compaction of the rocks of the future basement and a possible lowering of the groundwater level by dewatering are predicted.

The construction of the proposed power plant is planned to be carried out within the earliest possible time with the application of the developed nature-oriented technologies that will make it possible to minimize the impact on the geological environment.

7.7 IMPACT AT THE OPERATION STAGE

Impact on the atmospheric air

Nowadays pollutant concentration in the atmospheric air of the enterprise location area is big enough. Besides, under the results of the long-term monitoring of the atmospheric air it was determined that the concentration of dust, nitrogen dioxide and carbonic oxide has increased three times for 18 years.

- There is a stable tendency of the significant deterioration of the atmospheric air quality over the years. Rejecting the facility replacement with a new, more producible and environmentally friendly one will preserve this tendency and worsen the environmental situation in the region.

The estimation of the pollutant concentration in the atmosphere are made under the three scenarios:

- Existing condition
- Maximum development (the projected power-generating unit sources are added to the existing emission sources)

It is necessary to mention, that the estimation is made for the situation when all units work with peak load, that extremely rare happen in practice. At the next stages of projecting operation conditions of facilities will be specified and the probability of such a situation will be estimated. The projected combined cycle gas turbine power plant is characterized by a significantly lower emission rates.

Acoustic regime impact

As it generally known, there is an acoustic discomfort zone for any fuel combusting enterprise. The estimation made shows, that the acoustic discomfort zone for the enterprise does not exceed 180 m that is much lower sanitary protection zone of the facility.

In order to reduce the noise level made at the projected plant it is planned to introduce a number of activity, among which are:

- Sound levels, created by the proposed facility, must not exceed 75 dBA within one meter of coating.
- The sound-deadening system of GTP air intake duct must provide the reduction of the sound level up to 75 dBA at the distance of 1m from the surface of air intake.
- The installation of sound attenuators into ventilating systems, serving the rooms with the permanent people stay.
- The application of sound protecting enclosure inside the room.
- The installation of ventilators with vibration isolators.
- Connecting ventilator sets with air duct through flexible connectors etc.

7.8 LANDSCAPE AND VISUAL CHANGES

The site for the proposed plant is purchased from Mirpurkhas Sugar Mills from their premises and there were warehouses earlier at the side singled out for the construction. Therefore, the planning activity is not connected to the deforestation of woody shrubby vegetation, the elimination of greenery and will not lead to the reduction of green plantation size within the region of the object location, and will even allow increasing the green plantation size within the green space work.

7.9 MATERIAL UTILIZATION AND WASTE MANAGEMENT

The waste products generated in the course of the operation will be same as that of other bagasse based cogeneration power plants.

However, the frequency of transformer fluid, accumulator battery change will be reduced with putting the proposed facility into the operation, as the performance life of the plant transformers is 30 years without oil change, and the performance life of accumulator batteries is 25 years.

The opportunities for minimization the quantity of waste generation will be searched out in the course of organizing the management system of waste that are generated during the operation:

- Sorting out is made according to the classes of danger with the subsequent division of waste products which depends on the type (this division makes the waste management procedure easier as well as the process of recycling more economical).
- All actions on the collection and storage of waste shall be done according to the Project of Standards on Waste Generating and Disposal Limits

- Location, projecting and operating of objects are to be organized in such a way that provides work condition security as well as minimization of potentially unfavorable impact of stored waste on the environment, constructions and public health.
- Sorting out waste products is to be made according to their class of danger, their physical and chemical properties when collecting and storing them.
- Operations of waste collection and storage are to be provided with containers of appropriate size and for the waste which has a relevant danger class, adequate physical and chemical properties.
- Marking of containers, used for waste collection and storage, as well as registration in respective documents of such data as a source of waste products, their quantity, a danger class, a collection date and a date of disposal at the production facility with the purpose of storage are to be made.
- Sorting out and storage of waste products are subjects to take into account the way of their final application (i.e., the waste for recycling is provided to be stored separately from the waste for neutralization and disposal).
- Collection of household rubbish in plastic packages, washing and disinfecting the containers which were subject to rupture or damage are to be provided etc.

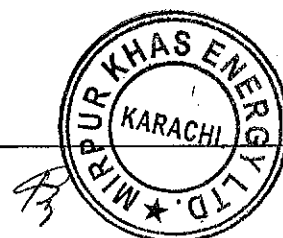
Impact on the surface-waters

Water withdrawal for the plant will be made from the tubewell and the nala canal as an alternate (if required).

The volume of the surface-water withdrawn remains at the same level. Separate collection of sewage allows guaranteeing a high quality of sewage treatment. Foul drainage from the sanitary sewage system will be made into the available sewage system of the facility, and further into the municipal sewage system.

Rainy and industry storm drains are to be exported by a net of gulley into the storm sewage system. An opportunity is provided for making laboratory tests that check the quality of water to ascertain whether it is necessary to establish a water treatment systems before the water drainage into the common sewage system. Than the water is exported into the local municipal disposal system.

Drains dirty with mazut and oil are exported into the oil and mazut drain tanks for the subsequent treatment. The treated sewage are directed into the cycle of water processing, oil-slime is drained into the oil-slime storage unit.



Impact on the groundwaters

A significant impact on the groundwaters is not expected in the course of operation. Effective measures against leakage out of reservoirs and the underground water-bearing communications must be developed within the project.

The leakage and soakage of polluting substances from the adjacent areas are probable negative factors worsening the quality of the groundwaters. Organized permanent monitoring of the groundwaters allows identifying and eliminating the probable entrance of the polluting substances.

Impact on the soils

The most significant impacts on the site soils are mechanical movements, warehousing into piles and clamp as well as soil replacement. These impacts may be positive by the renewal of earlier polluted soil cover. The impact may occur in the course of operation when oil products may leak. For this case an activity complex is provided for the protection from leakage which includes:

- application of special anticorrosive coats;
- technical examination, diagnosis and testing;
- computation of wall thickness on the basis of providing strength and safe operation by the working temperature range;
- Periodic examination and control etc.

Dangerous waste storage on the open soil is precluded as it may cause the entrance of polluting substances into the soils.

7.10 IMPACT ON THE GEOLOGICAL ENVIRONMENT

Construction yielding by building and construction operation is expected to be minimum and short-term.

Vibration attending the machinery work will not have a negative impact on the foundation soil. These soils do not have such a negative feature as thixotropy and will not reduce their bearing value.

Watering the green plants by landscaping is projected within the consumption that is not enough to provoke underflooding the area.

Impact on the social and economic conditions

The main impact of the construction and operation of the project on the economy of the town and the Territory on the whole will be connected to the disposition of the contracts for building and for procurement of construction materials. It is also planned to conclude contracts with local companies

for execution of work on transportation and disposal of solid domestic waste, delivery of necessary materials and facilities.

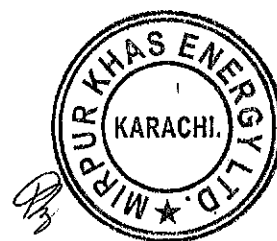
The impact of the construction and operation of the project on the social economic conditions of the project area will be positive, and, first of all, infers creating additional job positions, increasing the income of workers and purchasing activity of the population due to material purchases and service providing for the construction needs.

The important impact of the project realization must become the growth of the work position amounts as in the town so as in the region. Industrial sectors where power industry plays the essential role intensively develop in the Territory and adjacent regions in recent years. In connection with this project realization there will also appear an opportunity that encourages the growth of electric and thermal power supply for domestic needs of the developing town, for social and commercial economy sectors of the town, the Territory and the whole region, the growth of salaries, the migratory population increase and the improvement of other social rates. Owing to the project realization all mentioned above rates either stabilize the social situation in the Territory, or make it better.

In the course of the project realization the industrial capacities will be provided by thermal or electric power from the captive production that will not negatively affect the electric power generation, energy supply of the town.

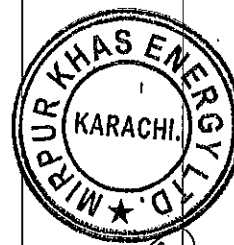
The construction and operation of power plant will not make any pressure on the existing health service in the town, as the town has the necessary capacities to render such kind of services.

As new land allotment for the new object construction is not required, this will not influence on agriculture, resort territories. In whole a positive impact of this project is expected on the social economic situation in the project area.

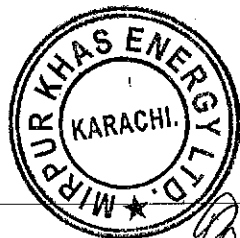


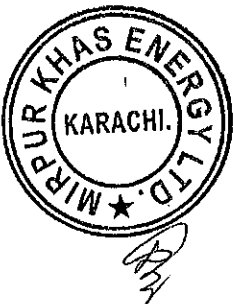
7.11 SUMMARY OF IMPACTS

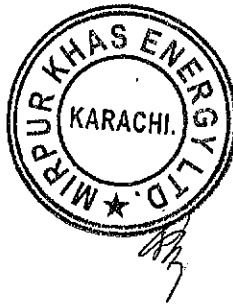
Impact on the environment	Suggested cushion activities	Residual impacts	Level of residual impacts
Impact on the landscape and the exterior view	<ul style="list-style-type: none"> • None of activities are suggested, as the surrounding landscape is the industrial one. The time of construction is limited. 	<ul style="list-style-type: none"> • No 	Insignificant positive impacts
Impact on the atmospheric air	<ul style="list-style-type: none"> • Development of procedures on irrigation of road surface before the construction work begins; material storage in piles to minimize dusting. As far as necessary use closed trucks to transport discrete materials from the site in order to prevent dispersion by transportation. 	<ul style="list-style-type: none"> • Dusting in the course of construction work The impact is significantly reduced 	Insignificant negative impacts
Water pollution as a result of possible leakage of fuels and lubricants and chemical substances in the course of the construction work.	<ul style="list-style-type: none"> • To allot a special ground with a protection from leakages for the purpose of storing potentially polluting substances. Development of working instructions to guarantee the right treatment of these materials. 	<ul style="list-style-type: none"> • Impact risk is significantly reduced 	Insignificant negative impacts
Waste generation by the construction work	<ul style="list-style-type: none"> • Development of procedures of waste control and storage to guarantee the right identification of waste, rules of storage safety, reuse or recycling, where the transportation to the special site is possible. 	<ul style="list-style-type: none"> • Generation of construction waste volumes which are to be buried in the course of the assumed activities. 	Insignificant negative impacts
Noise	<ul style="list-style-type: none"> • Development of the plan to control noise. It may include: • Switch off plants and facilities when they do not work. 	<ul style="list-style-type: none"> • Reducing the level of noise impact. 	Insignificant negative impacts

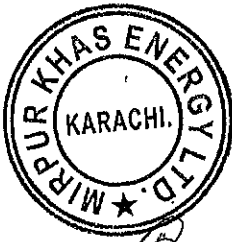


	<ul style="list-style-type: none"> • Determine the site working hours. • Develop a work program to minimize the work during the non-working hours (not daytime). • A brief instruction of all workers about the noise control measures. • Use temporary screens or partial enclosure of the territory, where the activity takes place. 		
Impact on the atmospheric air	<ul style="list-style-type: none"> • Development of normative standards of maximum permissible emissions for the sources of all pollutants, providing the correspondence of near the ground concentrations at the bounds of sanitary protective zone to the maximum permissible concentrations. Development of activity on the emission regulation during the period of unfavorable meteorological conditions. • Organization of permanent control after pollutant emissions into the atmosphere with the application of the results of planned observations. 	<ul style="list-style-type: none"> • After putting the plant into the operation the concentration of most pollutants in the atmospheric air remain the same or decrease. • The emission of green greenhouse gases decrease. 	positive impact
Possibility of emergency developing	<ul style="list-style-type: none"> • Surface air monitoring at the bound of the sanitary protective zone and the zone of facility influence. • Possibility of emergency developing • Investigation of the whole range of possible measures and means, which may 	<ul style="list-style-type: none"> • Operation of the proposed plant may increase danger. However, the creation of environmental safety management system, representing the aggregate of juridical, organizational and economic 	Insignificant positive impacts



	<p>be opposed to the dangerous factors with the purpose of their parrying within the advantages of the environmental safety.</p> <ul style="list-style-type: none"> • Quantitative analysis of the possibilities for one or another situation to appear, of effectiveness of different measures and means of their parrying. • Creating the system of a complex monitoring and management of environmental safety. • Taking a complex of decisions, that excludes depressurization of facilities and preventing emergency emissions of dangerous substances as well as reducing corrosive attacks of pipelines and shut-off-and-regulating fixtures. • Proving disclosure means to control emergencies. • Development of fire prevention activities. • Having a plan of work on liquidation emergency spill of fuel, lubricants and mazut. • Development of procedures on preventing emergencies (including fire, spills, etc.) • Provide the respective training for personnel and give out the necessary equipment. 	<p>mechanisms, intended to decrease the environmental risk to the acceptable level, and in case of emergency with an impact on the environment to provide security to people and to the environment, will help to achieve the maximum reduction of possible damage and compensation of the caused loss.</p>
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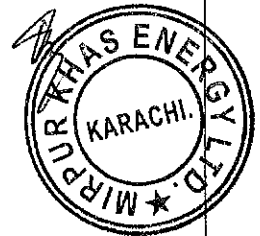
Impact on surface-waters	<ul style="list-style-type: none"> • Application of separate system of sewage disposal • Application of modern systems of water treatment, grounded on the analysis of sewage quality. • Monitoring the condition of water from the surface sources. • Quality control of entering and exporting of sewage. • Liquidation plan correction of oil product overflows and its approval. 	<ul style="list-style-type: none"> • The impact on surface-water is minimized 	Insignificant positive impacts
Impact on soils	<ul style="list-style-type: none"> • Mechanical removal, storage into piles and clamps as well as soil replacement with a qualitative one. • Organization of specialized places to exclude the soil contact with the substances of higher danger. • Development of the complex of activities which exclude the possibility for oil products to leak on the soil surface. 	<ul style="list-style-type: none"> • Soil quality improvement at the expense of the replacement of degraded soil with a qualitatively new one. • The possibility of potential soil pollution being a result of oil spill is insignificant due to the application of preventive measures complex. 	Insignificant positive impacts
Waste generation	 <ul style="list-style-type: none"> • Permanent monitoring of the waste disposal places. • Approval (renewal) licenses and permissions on waste treatment. • Having approved instructions on collecting, storing and transporting the production waste. • Making records of all data about the delivered and recycled waste and 	<ul style="list-style-type: none"> • Insignificant change of qualitative and qualitative composition of waste • Waste impact on the environment is assessed as insignificant under the condition of realizing the developed projected decisions concerning the rules of temporary storage and established frequency 	Minimum positive impact


	<p>providing the respective reports.</p> <ul style="list-style-type: none"> • Waste sorting out and storage with account of the direction of its finale usage. • Marking of containers, used for waste collection and storage, as well as registration in respective documents of such data as a source of waste products, their quantity, a danger class, a collection date and a date of disposal at the production facility with the purpose of storage. • Maximum possible replacement of toxic materials with less dangerous. • Sorting out according to the classes of danger with the subsequent waste separation depending on the type. • Activities on reducing the amount of generated waste. 	<p>of their removal to recycling and disposal.</p>	
Impact on groundwaters	<ul style="list-style-type: none"> • Development of measures against leakage from reservoirs and from the underground water-bearing communications. • Development of the system of hydrogeological monitoring. 	<ul style="list-style-type: none"> • The possibility of the impact on the groundwaters is small. 	Minimum impact positive
Impact on flora and Fauna	<ul style="list-style-type: none"> • Accomplishment of the works on landscaping. 	<ul style="list-style-type: none"> • Landscaping work will allow to extend the area of greenery. 	Minimum impact positive
Impact on the geological environment	<ul style="list-style-type: none"> • Speeding up the construction terms and observing the recommendations of the 	<ul style="list-style-type: none"> • The subsidence of buildings in the course of use of buildings and 	Extremely insignificant negative

	IEE (EMP) section, which exclude pollutants entering into the open trenches and pits. • Monitoring of the impact on the geological environment.	<p>constructions is expected to be minimum and short-term.</p> <ul style="list-style-type: none"> • The impact of vibrations and impoundment of areas is extremely insignificant. 	Impact
Social impacts		<ul style="list-style-type: none"> • Creating additional jobs. • Increase of employee incomes and population purchasing activity due to procurement of materials and supply of services for construction necessities. 	Positive impact

Overall Impact of the Project and Conclusions:

Like any new projects undertaking there are short term measures and factors to be mitigated, however, the MEL project being bagasse, and not fossil fuel, based have net positive impacts. The sponsors have been provided with and have committed to undertake the stated project related mitigation measures and to put in place the monitoring plan. On the basis of the study and the stated measures associated with plant construction and operation, the 26 MW bagasse fired power plant is recommended to be given Initial Environment Examination clearance. More so, because it is adjacent to the Mirpurkhas Sugar Mill, and at a site which stands cleared previously for stated industrial activity. This it is an extension of industrial activity. Furthermore, due to firing of clean fuel (bagasse) the project is expected to earn carbon credits. In conclusion, as environmental consultants, we consider that consent may be given by the concerned regulatory authority as the project meets the requirements laid down in the Initial Environment Examination



 Mirpurkhas Energy <small>Mirpurkhas Energies Ltd, A subsidiary of Mirpurkhas Sugar Mills & An affiliate of Ghulam Faruque Group (GFG).</small>	Revision Number	00	Reference Number	MEL/HSE/001
	Amendment	00	Date	25- Dec- 2016
	Document Title	HSE PLAN		

REVIEW AND APPROVAL SIGNATURE RECORD

ROLE	TITLE	SIGNATURE	DATE
Originator	Senior Manager - HSE		Dec 24, 2016
Reviewer	Group Head – HSE		Dec 25, 2016
Approved by	CEO – MEL/MSM		

RECORD OF REVISION

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00	Safety Plan for 26 MW Bagasse based Co-generation Power Project.	25 DEC 2016

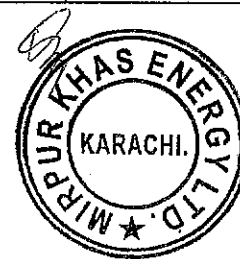
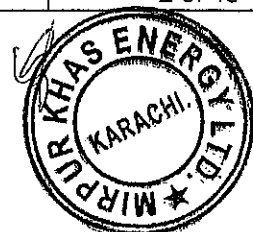


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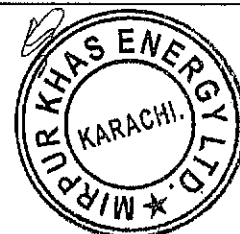
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1.0 POLICY:



Environment, Health, Safety, Security & Quality Policy (EHSSQ)

In our quest to keep our employees, assets and our environment protected, MSM/MEL is committed to highest Safety, Health & Environment Standards By:

- Making Environmental, Health & Safety Considerations a priority in business planning and decision-making process.
- Providing a secure Healthy & safe workplace for employee, customers and contractors.
- Ensuring MSM/MEL's EHS Policy and key performance initiatives are current and measureable against national and International standards.
- Monitoring, Evaluating, Implementing and tracking change management based on ISO 14001, and OSHAS-18001 and national standards.
- Ensuring employee development through advanced training which serves to expand and emphasize EHS awareness as a continual process.
- We are committed to achieve effective EHSSQ Management Performance that maximize the values and promotes openness with stakeholders.
- We are committed to provide quality products while ensuring reliable operations in safe and secure manner to prevent accidents, ill-health and injuries. We shall operate with respect and care for the environment.
- We shall have EHSSQ Management systematic approach to comply with applicable quality standards. , This is regarding to Health, Safety, Security, Environmental Laws & regulations and other requirements and meet Responsible care Guiding Principles.
- We shall continue to improve our systems, processes and effectively implement developed programs to enhance the competence of our employees. Also, increasing the awareness of our stakeholders
- We shall comply with sustainability requirements, prevent pollution, reduce waste, minimize risks of operations and conserve resources.

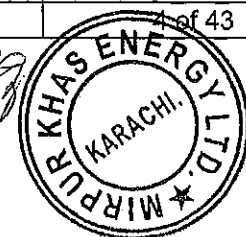
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2.0 SCOPE OF WORK

Construction & Erection of 26 MW bagasse based Co-generation Power Plant Project. Which includes electrical, instrumentation, piping, and insulation of piping, erection and installation of extraction cum steam turbine, blasting and painting of newly installed lines, steam tracing, hydro testing, weather proofing, preparation of as-built drawings and pre-commissioning/Commissioning activities.

Piping demolition and erection

Field verification of all routing, dimensions and locations of existing lines. Insulation removal and field marking the lines to be demolished and cross checking with client. Cut and dismantle the marked portion of pipes. Pre-fabrication and erection of pipes as per drawing. All NDT requirements to be carried out as per the requirement. Tie-ins to existing lines as shown on piping project drawings. Hydrostatic test to be conducted as per the requirement. Blasting and painting to newly installed lines.

Demolition and Installation, in the existing vessel for installation of new nozzle... Radiography and PWHT to be carried out as per the requirement. Blasting and painting. Marking and getting clearance from client for welding. Conducting hydrostatic test as per the requirement, Insulation and carry out inspection.

3.0 ORGANIZATION CHART

Note: The telephone numbers of the Safety Manager and Safety Supervisors (day & night) will be provided as an addendum to this organization chart at the time of mobilizing the man power to the site to ensure the communication is appropriate to the actual deployment at project site.

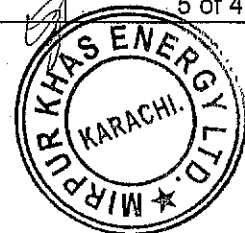
4.0 HAZARD IDENTIFICATION PLAN

HIP shall be based on initial hazard identification data which will be provided by the Consultant of the project and MEL team shall conduct site hazard identification tour with Lost prevention representative prior to start construction thereafter MEL shall prepared HIP and submit for approval. HIP is a procedure which integrates accepted health and safety principles and practices into a particular operation. In a HIP, each basic step of the overall task is examined to identify potential hazards and to determine the safest way to do the job. (See the HIP attached form 33.6).

Our plan includes:

- Forming the Hazard Identification team comprising of minimum of: Team leader, Team coordinator, members from Mechanical, Electrical, Civil and Planning & HSE as well.
- Obtaining location map and required drawings.
- Three basic stages in conducting a HIP plan are :

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Breaking the task down into a sequence of steps

Identifying potential hazards

Determining preventive measures to overcome these hazards

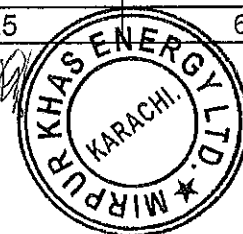
- All hazards will be taken up, control measures to bring them under tolerable risk or acceptable level of risk will be identified and the same will be implemented at the site before start of work.
- Review of the HIP prior to start of the work. Every incident / accident / property damage will be taken up and the effectiveness of control measures will be reviewed for any change.
- Communication, Documentation & Records pertaining to this plan will be the primary responsibility of Safety Department and providing the resources will be the responsibility of the Project Head.
- Any change in the drawings or change in the process of work will need a review by the team before effecting changes.

4.1 HAZARD IDENTIFICATION PLAN TRAINING (HIP)

Our HIP training and the classification of hazards. Our plan includes:

- Forming the Hazard Identification team comprising of minimum of: Team leader, Team coordinator, members from Mech, Elec, Civil, Planning and HSE.
- Obtaining location map and required drawings.
- Identification process will use the sample format as given vide our checklist 34.6 attached along with this plan.
- If any detailed study is warranting the process may be followed using: HAZOP tools such as Fish bone, Fault Tree or Event Tree as it is suited to.
- The identified hazards will be classified as :
 - ✓ Class A hazard – Leading to Fatality, Permanent Disability and or causing extensive damage to the property / properties
 - ✓ Class B – Leading to serious injury or ill health including temporary disability and or property damage less in severity.
 - ✓ Class C – Leading to minor injury such as cut, wound, abrasion requiring first aid or a medical treatment and without any appreciable damage to the property.
- Listing of such hazards will be taken up, control measures to bring them under tolerable risk or acceptable level of risk will be identified and the same will be implemented at the site before start of work.
- Review of the HIP after every incident / accident / property damage will be taken up and the effectiveness of control measures will be reviewed for any change.
- Communication, Documentation & Records pertaining to this plan will be the primary responsibility of Safety Department and providing the resources will be the responsibility of the Project Head/Manager.
- Any change in the drawings or change in the process of work will need a review by the team before effecting changes which will be controlled through the "Change Control Documentation" as per MSM/MEL's EHSQ plan.
- Training of personnel and communicating the hazards to the personnel will be thro our training plan

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submitted in this report.

5.0 SAFETY POLICY AND ASSIGNMENT OF RESPONSIBILITIES

Line Management has the ultimate responsibility for implementing the required procedure.

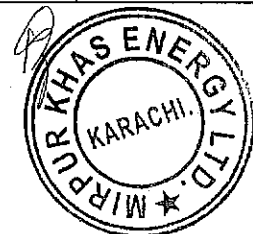
5.1 Project Head:

- Ensure that, HIP and HSE Plan for the project are effectively implemented.
- Attend safety meetings and implement all outcome of this meeting in his site.
- Ensure that safety is not compromised at any time to meet other project parameters and expectation such as those relating to cost and schedules.
- Ensure that all critical and hazardous tasks and activities are adequately planned and that appropriately HIP are communicated and discussed with the concerned discipline foreman and his crew.
- Ensure that jobsite supervision is affected at all times from dawn to dusk.
- Actively participate in Weekly/Monthly HSE Meetings.
- Conduct site visits frequently and monitor safety aspects at the project during the visits.
- Investigate all accidents with the help of HSE Manager/Site Safety Supervisors to establish causes and remedial measures to prevent re-occurrence.
- Give strict and strong instructions to all sub-ordinates to demonstrate their HSE responsibilities mentioned in the Plan.
- Provide suitable facilities for first aid and medical assistance.

5.2 Engineers/Supervisors/Foremen

- Ensure effective supervision at the work areas and implement all HSE Standards as per the site Safety Plan.
- Implement good housekeeping practice in their areas of activity.
- Ensure that HIP discussed prior to start work.
- Arrange pre-job meeting before starting any work.
- Conduct Behavioral Base Safety Observation and enforce for safe work practices.
- Report all near misses and or incidents to the Site Health & Safety Supervisors immediately.
- Ensure that the relevant Safety Instructions, Signs and Symbols are displayed in the prominent areas.
- Ensure that all personnel are wearing the relevant PPE.

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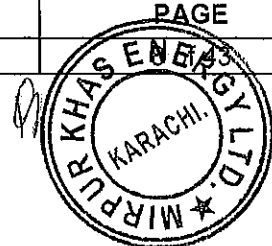
5.3 Site HSE Manager

- Ensure that HSE Management System of the Company is effective.
- Ensure that Safety Procedures are communicated to all personnel within the organization as well as Sub-contractors & Suppliers.
- Conduct HSE Audit regularly to update the safety performance of the company.
- Conduct Behavioral Base Safety Observation and enforce for safe work practices.
- Conduct site visits frequently and monitor the HSE activities.
- Give instructions and guidance on HSE matters to all key personnel at the site on the need basis.
- Participate actively in project meeting.
- Ensure the placement of the competent safety professionals to look after the site safety activities.
- Conduct HSE Training for the concerned management personnel before the commencement of the site activities.
- Assist site management in preparing HIP and other relevant plans as needed.
- Prepare the Monthly HSE Statistics Reports in the prescribed formats.

5.4 HSE Engineer/ Sr.Supervisor

- Ensure compliance of Safety Plan requirements. Render technical assistance on Safety throughout all phases of the project.
- See that the mandatory Safety and Security rules and Regulations of the Company are being observed and implemented.
- Establish the need for Safety Equipment, first aid, fire protection, hygiene and sanitation etc. to ensure minimum safety & health requirements are met.
- Ensure the integrity and operational reliability of on-site Fire Fighting Equipment is maintained.
- Respond to all emergency events to provide support and expertise as required.
- Timely reporting of incidents.

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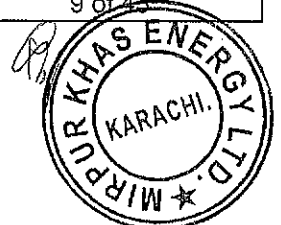


- Facilitate the investigation of all incidents. Ensure root causes are identified, controls established and implemented.
- Participate in and conduct Safety Inspections and Audits at all project locations and activities. Render reports to the Project Head after reviewing of Group HSE Head for appropriate actions.
- Maintain a constant moving patrol of assigned work areas to observe unsafe acts/conditions, and implement the actions necessary to correct non-compliance.
- Follow-up on the implementation of Corrective & Preventive Action. Evaluate the effectiveness of Controls.
- Prepare Safety awareness and promotional material.
- Responsible for preparation and maintenance of safety promotion activities such as displaying safety posters, safety signs, banners and publication of safety newsletters, etc.
- Attend weekly Project Safety Meetings.
- Monitor Housekeeping in assigned work area.
- Stop any activity immediately on detection of any substandard act, condition or potential hazard that would or could cause harm to an employee. (STOP the accident that is going to happen...)

5.5 Site Health & Safety Supervisor

- Site Health & safety officers will be responsible to implement all the Safety requirement of the Project.
- Conduct daily site inspections distribute reports to the HSE Supervisor and Prepare the daily safety reports and ensure that corrective actions taken for all adverse remarks.
- Conducts the weekly Toolbox meeting assures each employee signs the sheet having received the training.
- Assists in the investigation of any incidents/ Near Misses and communicates the learning points to all employees.
- Conducts periodical inspection of vehicles, equipment, hand tools and fire fighting equipment etc.
- Plan and conduct HSE Indoctrination training for all new employees and records the training on the Training Sign-In log.
- Safety supervisors will be on site while work is being performed.

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Each employee is empowered to stop work if they feel their or their co-workers health and safety could be compromised by performing the assigned task. Each employee is empowered to stop anyone from performing an unsafe act or creating an unsafe condition.

6.0 SAFETY INSPECTION

6.1 General Requirements

The Project-Activity Checklists are based upon minimum regulatory compliance and some site-specific requirements may be more stringent. The MEL shall use these checklists to assess the adequacy of site-specific safety requirements and determine if employees will be safe. The objective of the checklist inspection process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. The checklists, including documented corrective actions, shall be made part of the permanent project records and maintained by the HSE Supervisor

6.2 Deficiency Tracking System

6.2.1 Behavioural Base Safety

MEL believes in behavioral monitoring procedure. Behavioral observation will be done by all Managers, engineers and Supervisors. They will make observation of Tools and Equipments, unsafe position, unsafe location, Apparels, Pre Task safety Meeting, HIP, Barricades, permits, etc on daily basis. Both good behaviors and questionable or unsafe behaviors will be annotated on the form and discussed with the observed worker(s) and his foreman. Any unsafe behavior or acts observed will be documented in writing to the project Head for action.

6.2.2 Safety Audit

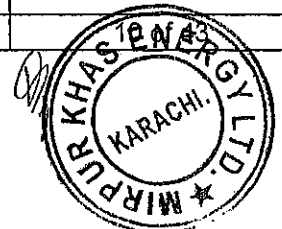
Site HSE Manager & supervisor will regularly conduct a daily Safety Audit to evaluate company safety performance and discuss with project Manager and Supervisor to make corrective action for those unsafe work practices, equipment condition, tools condition, PPE usage, work permit compliance, housekeeping, etc. Inspection shall be documented using appropriate checklist.

6.2.3 Checklists

All Site supervisors, Engineers, skilled personnel and safety Supervisors will complete checklists on daily basis by using checklist form. Any item which is showing risk must be explained on the last sheet of the checklist, and followed up for corrective action. These risk assessment checklists once completed and signed by the inspector, reviewed with the applicable supervisor and / or employee and signed by the project Head will become a permanent record of inspection and part of the project files.

7.0 SAFETY RECORDS & REPORTS

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This section applies to the system of reporting issues related to safety and the minimum basic record keeping, which is not limited to the following:

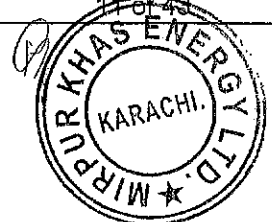
- Competency / Training / Certificates of critical workmen e.g. Welders, millwrights, Fire watch, Rigger etc.
- Procedures such as Policy, system procedures etc.
- Records such as: Near miss, Incident, accident investigation & analysis, inspection checklists, third party certificates etc.
- Communication records such as Behavioral base safety, Critical task risk assessment and communication, Safety committee meetings and minutes will be maintained as appropriate to Project Management Team requirements.
- Promotional activities such as: Suggestion scheme, Hazard identifications, best safe employee etc.
- Signs and boards as a part of awareness and isolation procedures in line with the PMT requirements.

8.0 CONTRACTOR CAMP SANITATION SAFETY

8.1 Drinking Water

- MEL will provide an adequate supply of potable water in all its work areas daily and test water supply weekly.
- Portable containers for drinking water shall be tightly closed and equipped with a tap. Water shall not be dipped from containers.
- Drinking water containers shall be clearly labeled as to the nature of its contents; and shall not be used for any other purpose.
- Drinking water containers shall not be opened in the field by anyone other than employees designated to service and maintains the containers.
- Non-potable water outlets shall be clearly labeled as being unsafe for drinking, or washing purposes.
- Portable water containers shall be cleaned weekly, using bleach wash and baking soda rinse.
- Single use drinking containers shall be provided at each water container. Adequate trash containers shall be provided to dump the single use drinking containers. The use of a common drinking cup will not be permitted. Personnel are not permitted to drink directly from the container.

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8.2 Toilets

- Toilet facilities shall be provided for employees to the ratio of one toilet per 30 employees in line with the client's requirements.
- All job site toilet facilities shall be serviced and cleaned on a regular basis and frequently as necessary determined by the amount of use and season of the year but not less than once per day.
- Portable/Permanent toilets on the project shall be strategically located so as to provide adequate coverage for all active work areas. In multi-story structures, no more than two (2) floors will separate each toilet.
- Hand washing stations should be provided.

8.3 Lunch / Break Areas

- Employees shall take breaks and eat lunch in designated areas only. These areas shall be free from hazardous materials or other possible contaminants.
- Lunch and break areas shall be removed from active work areas where employees would be exposed to on-going work while eating lunch or taking a break.
- Contractor shall ensure all trash, debris and food residues are cleaned up at the end of the break.
- Consumption of food shall be prohibited in work areas.
- The lunch and break areas shall be shaded against sun/ bagasse yards. The locations and requirement of such facility shall be approved by HSE dept.

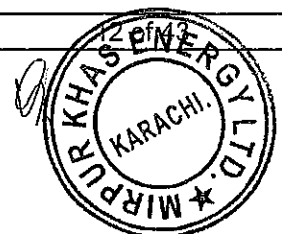
8.4 Smoking

- Smoking shall be **only** allowed in designated area.
- No employee will be permitted to carry match sticks or lighter for the purpose of smoking, but for carrying cigarettes.
- Any such violation will be considered as serious safety violation and suitable action will be initiated against the employee and may be removed from the project site.
- Tool Box talks on this subject will be taken up.
- Employees will be suitably advised & communicated on these lines prior to mobilizing to the project site.

9.0 WORK PERMIT

9.1 Purpose

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This procedure and guidance information has been developed to establish a safe and uniformed system for the issue of permits to work as per standard procedures.

9.2 Scope

This procedure is to be used by MEL members of the Project Management Team, Supervisors who supervise and control hazardous activities where a permit to work is necessary.

9.3 Definitions

9.3.1 Restricted Areas

Restricted areas are those areas or activities which have been designated by department managers as requiring the work permit system. These include (but are not limited to) areas where hydrocarbons, flammable liquids or gases, or oxidizing agents are handled, stored, piped, or processed in significant quantities; and critical non-hydrocarbon operations. The following are examples of restricted areas: Power & Energies; petroleum processing; pump stations; tank farms; loading piers; hydrocarbon pipelines; oil wells; gas plants; specified locations on marine vessels; gasoline service stations; areas where explosives and industrial X-ray or radioactive materials are used or stored; work areas under or near power lines; confined space entry; and material supply storage areas.

9.3.2 Issuer (Project Team)

Project Engineers/Managers are those who are certified by their division or department head to issue and approve work permits in restricted areas under their supervision.

9.3.3 Receiver (Authorized Craftsmen)

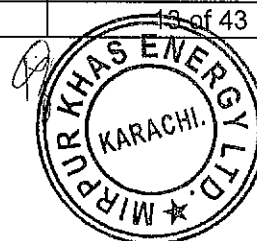
Authorized craftsmen are the craft supervisors, craftsmen, or others who have been certified by their division or department head to sign and receive work permits in the case of Company employees and by sponsoring organization heads in the case of contractors.

9.3.4 Work Permit;

There are four work permits:

- **Release of Hazardous Liquids or Gases, (yellow) -**
This form is required when opening lines or vessels that may release hazardous or toxic materials.
- **Hot Work, (red) -**
This form is required when using spark or flame producing equipment and for vehicle entry into a restricted area.
- **Cold Work, (blue) -**
This form is for work that will not produce sufficient energy to ignite Flammable atmospheres/materials.

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- **Confined Space Entry, (green) -**

This form is required for tank cleaning, tank inspection, work in sewers or excavations of 4 feet or deeper.

All work in restricted areas must have at least one of the listed work permits. Work must be performed according to the instruction and precautions specified in the work permit.

9.4 Function of work permit system.

Work permit forms must be used as appropriate for specific work on a specific site. The work permit forms are for all types of work in restricted areas. Work permits must be issued for any of the work or combination of the work identified as mentioned

9.5 Right to stop work and cancel permits

Work permits will be suspended or cancelled if conditions change or an emergency develops.

9.6 Closing work permits

Work permit shall be closed after the work is finished. (As per standard procedures)

9.7 Certification of issuers and receivers of work permits

1. MEL work permit receiver will be approved by Project Management Team's Training & Career Development and will stay at the work site for the duration of the work permit valid.
2. All the work permit receivers must have valid work permit certification issued by Company's Training Career Development after successfully completion of training and examination.

10.0 WELDING AND CUTTING

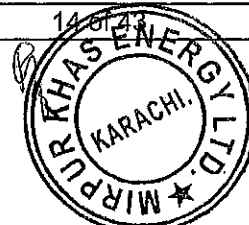
Welding is a safe operation if carried out in the correct manner. Where equipment is defective or there is no well-arranged, well-lit, properly ventilated working place, hazards will arise. All welding and cutting work shall be started after receiving work permit.

Gas Welding: Oxy-Acetylene Equipment and Use

Personnel working with welding equipment shall be trained, competent, and provided with personal protection equipment. Welding goggles, helmets, screens, forced ventilation and similar equipment shall be provided to all workers and to trainees in the immediate area.

10.1 Gases

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Oxygen (O₂) is odorless. It can promote rapid combustion; therefore, grease and oil must never be used near oxygen as this could cause fire. Welding, Cutting, and Brazing. Oxygen cylinders or apparatus shall not be handled with oily hands or gloves. A jet of oxygen must never be permitted to strike an oily surface, greasy clothes or enter fuel, oil or other storage tanks. Acetylene (C₂H₂) has a distinct odor often likened to that of garlic or sour apples. It is combustible when mixed with air over a wide range (2.5% - 81%). Acetylene burned with oxygen can produce a higher flame temperature than any other commercial gas. Acetylene becomes unstable at pressures above 103 kPa (15 psig) which means it may explode. Under no conditions shall acetylene be generated, piped (except in approved cylinder manifolds) or utilized at a pressure in excess of 15 psi gauge pressure. Inside the cylinder, acetylene is dissolved in acetone to prevent internal explosion; therefore, it is essential that acetylene cylinders be stored, handled, and used in the vertical position to prevent the liquid acetone from escaping and damaging the valves and other equipment.

Warning: Regulated Acetylene pressures must never be allowed to exceed 103 kPa (15 psig) or it may explode.

10.2 Storage of Cylinders

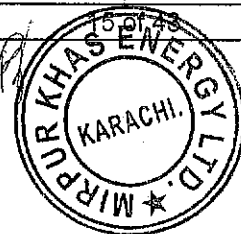
- Cylinders should be stored in a safe, dry, well-ventilated place prepared and reserved for that purpose. Flammable substances such as oil and volatile liquids or corrosive substances should not be stored in the same area. Oxygen cylinders and flammable gas cylinders shall be stored separately, at least 6.6 meters (20 feet) apart or separated by a fire proof, 1.6 meters (5 feet) high partition. All storage areas shall have Arabic and English "No Smoking Permitted" signs prominently displayed. All cylinders should be chained or otherwise secured in an upright position. To prevent rusting, cylinders stored in the open should be protected from ground contact, extremes of weather, or contact with water. Valve caps shall be kept in place when cylinders are not in use. Flammable substances shall not be stored within 50 feet of cylinder storage areas.
- Accordingly, they should not be stored near sources of heat such as radiators, furnaces, or near highly flammable substances like gasoline. Cylinders shall be stored out of the direct rays of the sun, in protective enclosures or sun shelters.
- Empty and full cylinders must be stored separately with empty cylinders plainly marked as such, to avoid confusion. Empty cylinders should be segregated according to the type of gas they have held.

10.2.1 Handling of Cylinders

Serious accidents may result from the misuse, abuse, or mishandling of cylinders.

- Cylinders should never be lifted by their valves since the valves are not designed to take such stress. When the cylinder is not in use, the valve shall be protected with the valve cap.

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- All valves must be fully closed before a cylinder is moved. Unless a trolley or special carrier is used, regulators and hoses should be detached from the cylinders, for moving. Welding, Cutting, and Brazing.
- Cylinders in transit on vehicles shall have valve caps in place and be firmly secured to prevent movement. Cylinders shall be secured to avoid any violent contact. Loading and unloading shall take place carefully. Cylinders shall not be dropped, thrown, dragged, used as rollers, or as a support. No damaged or defective cylinder shall be used.

10.3 Faults

It is not uncommon for minor "explosions" to occur during welding or cutting. Most are more frightening than harmful, but some can lead to very dangerous conditions. There are four general groupings of these faults:

10.3.1 Snap out can occur during use when:

- Both regulators are set at an incorrect pressure
- Torch nozzle obstructed
- Nozzle held too close to the work
- Corrective action:
- Completely shut both torch valves
- Check regulator setting
- Check cylinder pressures
- Check nozzles
- Ensure adequate gas flow

10.3.2 Backfire can occur on lighting up when:

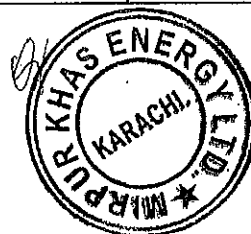
- Regulators not set to correct pressure
- Light applied before flow of gas mixture properly established
- Corrective action:
- Close both torch valves, oxygen first
- Check cylinder pressures
- Check and adjust regulator settings
- Cool torch and check nozzle orifice for obstruction
- Re-light

10.3.3 A flashback is very dangerous. Flashback is caused by gases being mixed in the hose(s). Usually this mixing of gases occurs when the hoses have been disconnected from regulators or torches or when a new hose is being used for the first time. Sometimes it is due to loose connections. Usually one of the hoses will have burst and possibly ignited.

Preventive action:

- Use flashback flame arrestors for regulator and torch
- Ensure all connections are tight
- Ensure cylinder valves are open and torch valves closed

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- Set regulators to the required pressures
- Purge each hose separately and consecutively by opening the torch valve and allowing gas to flow for sufficient time to ensure only pure gas remains in the hoses
- Close the valve for each gas as the purge is completed
- This purge should be carried out only in the open or in extremely well-ventilated areas
- Corrective action:
 - Close both torch valves February
 - Close both cylinder valves
 - Extinguish hose if alight
 - Repair equipment and hoses

10.4 Fuel Gas and Oxygen Manifolds

Fuel gas and oxygen manifolds shall bear the name of the substance they contain in English and Urdu letters at least 1-inch high which shall be either painted on the manifold or on a sign permanently attached to it. Fuel gas and oxygen manifolds shall be placed in safe, well ventilated, and accessible locations. They shall not be located within enclosed spaces.

Manifold hose connections, including both ends of the supply hose that lead to the manifold, shall be such that the hose cannot be interchanged between fuel gas and oxygen manifolds and supply header connections. Adapters shall not be used to permit the interchange of hose. Hose connections shall be kept free of grease and oil. When not in use, manifold and header hose connections shall be capped. Nothing shall be placed on top of a manifold, when in use, which will damage the manifold or interfere with the quick closing of the valves.

10.5 Electric Arc Welding

Arc welding is a process for joining metals by heating with an electric arc. For arc welding, two welding leads, the electrode lead and the work lead, are required.

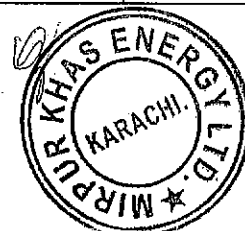
10.5.1 Voltage

The voltage across the welding arc is normally within the range 20-40V. The voltage supplied, however, needs to be somewhat higher so that means of stabilizing and regulating the arc current can be introduced into the circuit. Using DC, a 60-80V supply will usually suffice. Using AC, an 80-85V supply will suffice although some of the latest techniques need an open circuit voltage of up to 100V between electrode and work. It should be remembered that a nominal 100V supply has, in fact, a peak voltage of 141V. For these reasons, DC should be used for welding operations in any situation where the effect of electric shock is likely to be extreme, such as in damp and confined spaces (tanks, boilers, etc.).

10.5.2 Welding Connections

In each welding circuit there are three main connections: the welding lead; the welding return; the welding ground. All welding machines and accessories such as welding returns, welding ground, welding cable, electrode holders etc, shall be maintained in sound condition.

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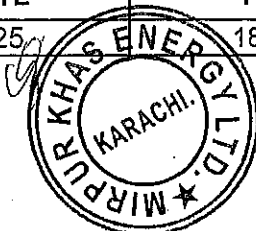
10.6 Protective Measures

- The need for the operator to take safety precautions and preventive measures during the operation of welding machines to ensure that no safety-related incident occurs cannot be overemphasized.
- Ensure that the engine protection push button 'pops out' when the engine is switched off. Under normal circumstances, this button will 'pop out' once the engine is switched off.
- Maintain welding and ground cables and connections in good condition and proper size.
- When welding is in progress, the full length of cable must be stretched out on the ground.
- Do not adjust the 'current control' while welding is in progress. This can damage the control. Sparks and molten or hot metal coming from the work area can easily set fire to combustible materials near or below the working area. Wherever possible, all combustible material should be removed from the work area. If it cannot be removed, it should be covered with fireproof material.
- Gas cylinders should be protected from falling sparks.
- Operators of arc welding equipment must always switch off the current to the electrode holder and remove the electrode whenever it is to be set down and is not actually in use.
- When welding or cutting material that is supported by a crane, a shield or an effective screen should be provided to protect the suspension ropes or chains. Grounding cables shall only be connected to the work, not to the crane or rigging.

10.7 Personnel Protection

- Helmets, welding hoods, and goggles are necessary to protect eyes and face Against heat and the effect of the intense light emitted by welding operations. These goggles should also be worn under the regular welding hoods.
- Electric welding operations must be effectively screened to prevent nearby personnel from being affected by harmful radiation. Screens should be made fro fire resistant materials or should be suitably treated with a fire resistant compound Screens should be designed and placed so as not to restrict the flow of air for ventilation purposes.
- Gloves are necessary protection to the hands against heat, sparks, molten metal, and radiation. Leather, suitably reinforced at points of maximum wear, is the material most generally worn. Gloves should be long enough to protect wrists and forearms.

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When gloves are not long enough, protective sleeves of similar materials should be worn.

- Safety boots and leggings are essential to provide effective protection against heat, flying sparks, and falling metal. Pant cuffs shall never be worn inside of the safety boot.

10.8 Health Hazards

Apart from the obvious hazards of physical burns, health hazards in welding operations fall into two classes: hazards from radiant energy and hazards from dusts and fumes.

10.8.1 Radiant Energy

The process of welding produces radiant energy in the form of visible light, ultraviolet rays, and infrared rays. The risk of this energy harming the operator or other personnel can be minimized by the proper use of protective clothing and shielding.

10.8.2 Respiratory Effects

The risk of being gassed in normal welding operations is slight. The current scope of work is not in confined space.

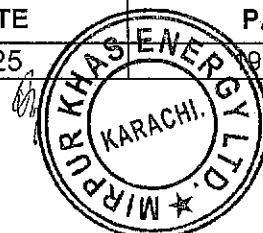
11.0 PERSONAL PROTECTIVE EQUIPMENT

- Approved hard hats, ANSI approved safety glasses, Fire retardant clothing and safety toe shoes/boots will be the minimum personal protective equipment utilized by all employees at the work site (except in designated area, i.e. offices).
- No athletic type shoes, open-toed shoes, or shoes not made of substantial materials and design will be allowed. The footwear must protect against the hazards that may be encountered at the work site. The use of loose clothing, jewelry, etc. will not be allowed.
- Additional personal protective equipment may be required as dictated by the client's regulations, types of work being performed, and hazards encountered.
- Hazards will be evaluated for the assigned work, the job type, and work location. Regulations for the proper use of designated personal protective equipment shall be conveyed to all employees and shall be strictly enforced.
- It is the policy of MEL that each employee utilizes industrial safety dust mask and glasses and frames as a minimum lungs n eye protection while at a job site. Certain jobs will require that additional eye protection be used as dictated by the hazards.

12.0 TOOLS & PORTABLE POWER TOOLS

- All hand tools shall be kept in good repair and used only for the purpose for which they are designed.

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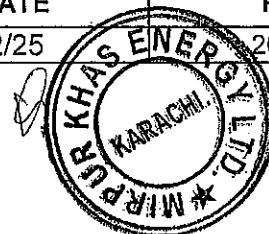


- Tools having defects that will impair on their strength or render them unsafe for use shall be removed from service.
- All Power tools should be double insulated or grounded.
- When work is being performed overhead, tools not in use shall be secured.
- Throwing tools or materials from one location to another, from one employee to another, or dropping them to lower levels, shall not be permitted.
- Only non-sparking tools shall be used in locations where sources of ignition may cause a fire or explosion.
- Power tools shall be inspected, tested and determined to be in safe operating condition prior to use.
- Power tools shall be operated only by authorized personnel.
- Employees using power tools shall wear protective apparel when it is necessary.
- Loose and frayed clothing, loose long hair, dangling jewelry, rings, chains shall not be worn while working with any power tool or machine.

13.0 LADDERS

- The safety of a ladder depends on four important factors: selection, condition, position, and use.
- A stairway or ladder is generally required when a break in elevation of 45 cm or greater exists.
- All portable must be maintained in good condition at all times.
- Personnel should avoid using both hands to carry objects while on stairways; if unavoidable, use extra precautions.
- Personnel must not use pan and skeleton metal stairs until permanent or temporary treads and landings are provided the full width and depth of each step and landing.
- Ladders must be inspected daily by a competent person for visible defects.
- A ladder must be of the proper length for the job to be done. If it is to be used for access or as a working place, it shall rise to a height of at least 3 feet (0.9 meter) above the landing place.
- Ladders must be used only for the purpose for which they were designed and shall not be loaded beyond their rated capacity.

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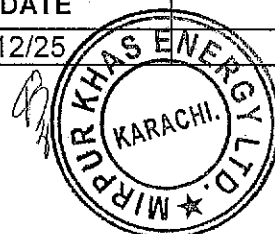


- Only one person at a time shall climb on or work from an individual ladder.
- User must face the ladder when climbing; keep belt buckle between side rails.
- Safe clearances shall be maintained to prevent workers from bumping into, or snagging.
- Straight ladders and extension ladders shall be placed at a slope of 4:1.
- User must use both hands to climb; use rope to raise and lower equipment and materials.
- Straight and extension ladders must be tied off to prevent displacement.
- Ladders that may be displaced by work activities or traffic must be secured or barricaded.
- Portable ladders must extend at least one meter above landing surface.
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder.
- Stepladders are to be used in the fully opened and locked position.
- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top or straddle a stepladder
- Fixed ladders greater than or equal to 8 meter in height must be provided with fall protection devices.
- Metal ladders, ladders with metal reinforced side rails, and ladders, which are wet, shall not be used near electrical equipment with exposed live conductors. Such ladders shall have a warning notice attached to guard against use near electrical equipment.
- Aluminum ladders shall not be used where there is likelihood of contact with materials harmful to aluminum, such as caustic liquids, damp line, wet cement, and seawater.
- Fall protection should be considered when working from extension, straight, or fixed ladders greater than 6 feet from lower levels and both hands are needed to perform the work, or when reaching or working outside of the plane of ladder side rails.

14.0 ELECTRICAL INSTALLATION AND EQUIPMENT

- All electrical work will be performed by qualified electricians familiar with the type of work, installation and safety requirements.
- No work is to be done on or in the vicinity of energized circuits unless adequate safety permit and measures have been taken.
- Energized wiring in junction boxes, circuit breaker panels and similar places will be kept covered at all times.

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- Temporary electric cords must be protected or elevated, but not secured with staples or on nails or other metal objects.
- Worn, frayed or otherwise damaged electrical cords, plugs or sockets are not to be used.
- Supply connection from any socket or extension lead will be with a plug. Bare wires are not permitted.
- Splices in electrical leads will not retain the mechanical and dielectric strength of the original cable.
- Cables passing through work areas will be so arranged as to prevent any tripping hazard or risk of damage to the cable.
- Items of electrical equipment used in a production area will be explosion proof.
- The use of naked bulbs is not permitted in areas designated to be hazardous by reason of content or use.
- Metallic enclosures to transformers or high voltage equipment will be grounded.
- Extension leads and temporary wiring will not be used as a permanent facility.
- Extension cords used with portable equipment will be of the three-wire type and of heavy industrial standard.
- GFI (Ground Fault Interceptors) are required on all temporary electrical circuits located in wet or damp areas.
- Lock out Tag out Procedure must be implemented at all the locations where ever the electrical live circuits or energized equipments exist.

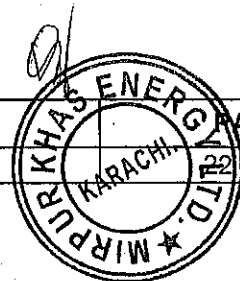
15.0 SCAFFOLDING

15.1 Standard & References

All scaffolds will be erected, dismantled, inspection, tagged and altered by trained scaffold builders and used as per the specifications and requirements of OSHA Scaffold Safety handbook. MEL will submit a scaffold plan to the local authority for review before erecting any scaffolds over 12.2 M (40ft).

15.2 Definitions

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Anchorage Safe points of anchorage for lifelines or lanyards, which are part of a personal fall arrest system, including fixed, substantial structural members. Anchorage points shall be fixed and able to support a load of at least 2,260 kilograms (5,000 pounds).

Base Plate A steel plate providing a flat bearing surface with a spigot or screw jack for distributing the load from posts (standards). It has an integral spigot and fixing holes for use with sills.

Bearer (Transom) A horizontal transverse scaffold member, that may support platform units, and which is supported by at least two runners (ledgers) or connected directly to at least two posts (standards).

Board Bearer (Intermediate Transom) A horizontal transverse scaffold tube upon which the scaffold platform partially rests. Board bearers are supported by runners (ledgers) and are not installed near a transverse line of posts (standards).

Box Tie An assembly of tubes and couplers forming a frame around a column or other part of a building to provide an anchor point for scaffold tie tubes. Also known as a column box tie.

Brace A rigid connection of scaffold tubing that holds one scaffold member in a fixed position with respect to another member to give the scaffold rigidity.

Coupler (Fitting, Clamp) A component or device used to fix scaffold tubes together. Types of couplers include:

Adjustable (Swivel) Coupler A device used for connecting two tubes together at an angle other than 90°.

Bearer (Single or Putlog) Coupler A device used for fixing a bearer (transom or putlog) to a runner (ledger), or to connect a tube used only as a guardrail to a post (standard).

Check (Safety) Coupler A Right-angle coupler added to a loaded joint on an under hung scaffold to give supplementary security against slip to the coupler carrying the load.

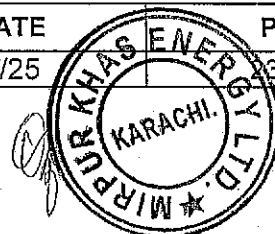
End-to-End (Sleeve) Coupler A device used for externally joining two (2) scaffold tubes coaxially end to end. The steel divider is located centrally to ensure equal insertion of each tube.

Girder Coupler A device used for connecting a scaffold tube to a steel wide flange beam (I-beam). Girder couplers shall only be used in pairs, one on each opposite flange.

Right-Angle (Double, 90 Degree, Load Bearing, or Standard) Coupler A load bearing coupler used for connecting two tubes together at right angles. It is a critical component in the scaffold structure and must resist both slip and distortion.

Fabricated Scaffold Plank, Deck, or Platform A scaffold platform unit equipped with end hooks that engage the scaffold bearer (transom).

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Full Body Harness A design of straps that may be secured about an individual in a manner to distribute the fall arrest forces over the thighs, pelvis, waist, chest and shoulders, with means for attaching it to other components of a personal fall arrest system.

Guardrail System A barrier consisting of top rails, mid rails, toe boards, and supporting uprights, erected to prevent workers from falling off an elevated work area and to prevent objects from falling onto workers below.

Top rail The uppermost horizontal rail of a guardrail system.

Mid rail A horizontal rail approximately midway between the toprail of a guardrail system and the platform.

Toe board A barrier secured along the sides and the ends of a platform to guard against the falling of material, tools, and other objects.

Ladder A device used for climbing vertically between levels, including:

Straight Ladder A portable ladder that consists of one section that determines its overall length. It cannot support itself or be adjusted in length.

Personal Fall Arrest System A system used to arrest an individual's fall. It consists of a substantial anchorage, connectors, full body harness, and may include a lanyard, deceleration device, lifeline, or suitable combinations of these

Plank (Scaffold Board) An individual timber board or fabricated component (without end hooks) that serves as a flooring member of a platform.

Platform An elevated work area composed of one or more platform units and a guardrail system.

Post (Standard) Vertical scaffold tube that bears the weight of the scaffold.

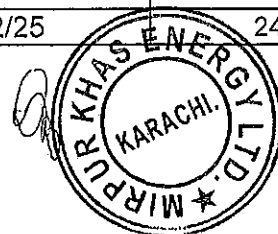
Safe Working Load (SWL) The manufacturer's specified maximum load to be applied to a scaffold component.

Scaffold A temporary elevated platform (supported or under hung) and its supporting components (including ties) used for supporting workmen, materials, or both. Types of scaffolds include:

System Scaffold A scaffold consisting of posts (standards) with fixed connection points that accept runners (ledgers), bearers (transoms), and braces that can be interconnected at predetermined levels.

Tube and Coupler Scaffold A scaffold constructed of steel tubing that serves as posts (standards), runners (ledgers), bearers (transoms), braces, and ties; a base supporting the posts; and specially designed scaffold couplers that serve to connect the various members.

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Sill (Sole Board or Sole Plate) A timber spreader used to distribute the load from a base plate to the ground.

15.3 General Requirements

15.3.1 Fall protection

- Fall protection shall be provided after 1.8 meters (6 feet). Fall protections include guardrail system and personal fall arrest system.
- Each scaffold craftsman shall continuously wear a full body harness with a shock-absorbing lanyard while erecting, altering, or dismantling a scaffold.

15.3.2 Guard Rail System

- Guardrail systems (consisting of top rails, mid rails, toe boards, and support uprights) shall be installed on all open sides and ends of all elevated work areas (including scaffold platforms and stair landings) where a person could fall 1.8 meters (6 feet) or more.
- The top edge height of top rails shall not be less than 0.95 meter (38 inches) and not more than 1.15 meters (45 inches) above the walking/working surface of a platform.
- Mid rails shall be installed approximately halfway between the walking/working surface and the top rail.
- Guardrail systems shall be able to withstand, without failure, a force of at least 90 kilograms (200 pounds) applied in any downward or horizontal direction at any point on the top rail or equivalent member.
- Guardrail systems shall be installed before an elevated work area may be used by anyone other than the scaffold craftsmen.
- Holes or gaps in elevated work areas shall have a guardrail system erected around them or they shall be securely covered with structurally substantial material.

15.3.3 Entry & Exit

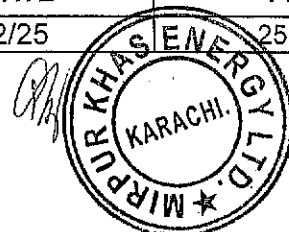
A safe means of entry and exit shall be provided and used whenever the elevated work area or scaffold platform is 0.6 meters (2 feet) above or below a point of access.

15.3.4 High Wind

Personnel shall not be on any scaffold or other temporary elevated work area during storms or high winds – sustained winds more than 65 kph (40 mph) - unless the scaffold or working level is indoors or otherwise unaffected by the weather conditions.

15.3.5 Capacity

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- All the scaffold and component must be able to support their own weight and four times more than the intended load.
- All scaffolds shall have a specified load rating, corresponding to the maximum intended load, of Light-duty (25psf), Medium-duty (50psf), or Special-duty (>50psf). For design, the maximum intended load (live load) shall be taken as the scaffold's load rating.

16.0 CRANES AND RIGGING EQUIPMENT

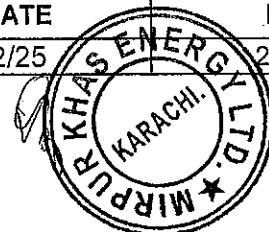
16.1 Crane And Rigging Equipment Test & Inspection

MEL shall designate a competent person to carry out a daily pre-operational inspection by using appropriate checklist. Deficiencies, reported in the daily pre-operational inspection that could affect the safe operation of crane/rigging equipment, shall be corrected prior to use.

- No crane/rigging equipment shall be used unless it has been certified with a valid Safety inspection sticker
- Crane/lifting equipment that has been involved in an accident, causing damage to the Crane /Lifting equipment, shall have its safety inspection sticker immediately removed by MEL.
- The AYT shall provide the necessary test weights, equipment, rigging hardware, and at least one (1) competent person to serve as an operator for initial, periodic, and any additional proof-load tests.
- The MEL shall provide the necessary test weights, equipment, rigging hardware, and at least one (1) competent person to serve as an operator for initial, periodic, and any additional proof-load tests.
- Any extensive repair, modification, or alteration to any Crane/lifting equipment requires a manufacturer's test certification to be furnished by the MEL to a certified inspector upon request.
- When a proof-load test is required, the MEL shall develop a proof-load test procedure and submit it to the Inspection Department for review and comment. The proof-load test shall be carried out by a Project competent person and witnessed by a Third Party certified inspector.
- Mobile cranes shall receive a periodic inspection every ninety (90) days or as determined by the Inspection Department.
- Mobile crane main boom sections, including power pinned sections, shall be extended and inspected for corrosion, proper operation, and damage, prior to use and during the periodic inspections.

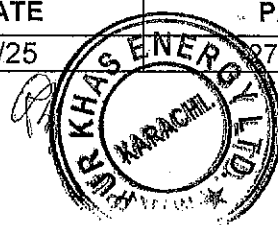
16.2 Crane lifts : Types And Procedure

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- The current scope of work does requires Critical Lift Plan to be accomplished for performance of the project
- The crane operator / Mechanical Head shall have the final decision on any crane lift that affects the safety of his crane.
- Certified riggers shall be used to rig all loads, regardless of weight to be lifted, configuration, or location. This includes such operations as standard and critical lifts, loading or off-loading trucks (including boom trucks), etc. The MEL shall provide, in writing, the weight of any load prior to the lift.
- All hydraulic cranes traveling inside plant facilities with more than the normally mounted boom sections shall do so in strict accordance with manufacturer's specifications and procedures. Hydraulic cranes, traveling with more than the normally mounted boom sections, shall not travel more than 1 km (0.6 miles). All crane turns shall be assisted by a flagman to ensure that the boom tip is clear of any obstruction.
- The use of operational aids shall not replace the requirements for verifying load weights, radii, and lift parameters.
- Standard and critical crane lifts shall not be performed in wind speeds exceeding 32 km/h (20 mph – 17.4 knots – 9 meters/second), unless otherwise specified by the crane manufacturer.
- Suitable knot-free and defect-free tag lines shall be used to control suspended loads, except when their use may create a greater hazard.
- The pinned extension of the hydraulic boom crane shall be extended prior to using a jib to obtain the maximum lifting capacity and radius.
- All cranes shall have their safe working load rating clearly visible in English. All information and warning decals shall be in English and Urdu when possible.
- All cranes shall be fitted with the following safety items: fire extinguisher, back-up alarm, spark arrestor (for cranes that are without an emission controlled engine system), and, if applicable, seat belts for highway driving.
- All cranes shall be leveled in accordance with manufacturer's specifications and shall be located on a properly compacted foundation prior to performing any lift. Welding or modification on load hooks and other lifting equipment is strictly forbidden.
- When outriggers are used, they shall be extended or deployed according to the crane load rating chart specifications. The crane's wheels shall be raised completely off the ground.
- Outrigger mats shall be used under all crane outrigger float pads during crane lifts (if applicable). Outrigger mats shall be designed to support the total weight of the crane

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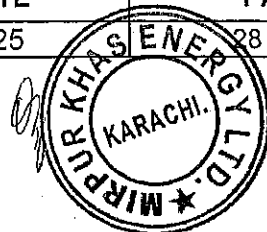
and load to be lifted. Any blocking (cribbing) used under outrigger mats shall be stable to avoid overturning or sinking into the soil. Outrigger mats shall not be permanently attached to the crane outriggers.

- All cranes shall have load charts available in the cabs stating lift capacity based on boom length, attachments, boom angle, outrigger configuration, radius, and lift quadrant. Load charts, if permanently attached to the crane cab wall, shall be positioned for easy visibility to the operator while he is seated at his control station.
- Cranes working in close proximity to operating high heat sources (flare stacks, etc.), that may affect the boom, sheaves, boom line, etc., shall take special safety precautions to protect such equipment from damage.
- Designated signalman shall be used at all times during the lifting, moving, and setting of a load. Only one designated signalman shall give signals to the crane operator. The type of communication to be used shall be determined prior to the lift by the MEL Project Manager. He shall also provide a full explanation of hand signals to be used, whether as primary or back-up communication.
- The designated signalman and crane operator shall verify that they are familiar with the same set of hand signals.
- The signalman shall wear a bright fluorescent vest for easy identification. Radio communication is preferred, especially in cases where signal relays are required. If, at any time, the crane operator does not have direct eye contact with the designated signalman, he shall immediately stop the crane lift operation until such time that he can again see the signalman.

16.3 Rigging Hardware Requirement

- All sling types shall have identification information permanently affixed with durable identification tags or wire rope swages and shall be maintained by the MEL so as to be legible during the life of the sling.
- Slings shall be shortened, or otherwise adjusted, only by methods approved by the sling manufacturer.
- Slings shall not be shortened or lengthened by knotting, by re-splicing, or by wire rope clips.
- Slings shall be hitched in a manner that provides the best control of the load.
- Slings or other rigging hardware in contact with sharp corners shall be padded with material of sufficient strength to minimize damage to the sling, other rigging hardware, and/or the load being lifted.
- Working conditions that may affect slings and other rigging hardware shall be considered, with special attention to temperatures, chemicals, abrasions, etc.

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- The rigging hardware manufacturer's rated SWL capacity shall not be exceeded.
- All attaching devices (i.e., rings, links, coupling pins, etc.) shall be selected to provide capacities equal to, or greater than, the slings used.
- Fasteners manufactured in-house from bolts, rods, pins, hooks, etc. **shall not** be used.
- Approved, self-closing safety latches shall be used on all hooks designed for safety latches.
- Aluminum is prohibited as a material for use as wire rope sling ferrules.

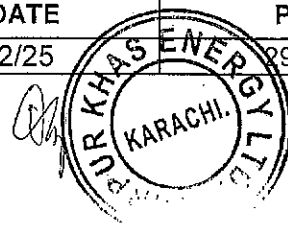
16.4 Crane Operator Testing and Certification

- Crane Operator must have TUV / Third party Heavy Equipment Operator Certificate and it should be valid.
- Crane Operators Must have Pakistan Government Crane Operator license and it shall be valid.

17.0 MECHANICAL EQUIPMENT

- All Heavy Equipment shall be inspected prior to use by using appropriate checklist.
- All posted speed limits will be observed at each job site.
- No vehicle will be driven at a speed or in a manner, which is dangerous to other employees or equipment, in respect to the type of vehicle and the area of its use.
- No motor vehicle will be taken onto a job site without specific authority from the client or Project Manager.
- Passengers are not permitted on any mechanized equipment, heavy equipment, forklift trucks or dump truck, unless specific seats are provided for the carriage of such passengers.
- No persons will be carried in or on any vehicle in a manner, which is likely to expose that person to risk of injury.
- No vehicle will be parked or used in such a manner as to restrict the free access of emergency vehicles or equipment.
- No vehicle shall be so loaded as to obscure the driver's view to the front or sides.
- Only authorized drivers with the valid permit for the specific piece of equipment will be permitted to operate equipment owned or leased to MEL.
- All employees operating any motor vehicle equipped with seat belts will wear seat belts.

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- Keys will be left in the ignition at all time when on the job site.
- Ingress & Egress - All employees shall follow the established routes at the job site, both vehicular and foot traffic.
- Pedestrian and bicycles shall have the right of way over vehicular traffic.
- Vehicle horns will be used for safety and at blind corners.

18.0 TRANSPORTATION

- It is the responsibility of the driver to inspect the vehicle by using appropriate checklist and ensure that his vehicle is safe to operate.
- It is the responsibility of each driver to take his vehicle to the proper facility for servicing and repairs when they are required or scheduled.
- The driver of the vehicle is fully responsible and accountable for the mechanical and physical condition of the vehicle. He must report any damage, beyond normal wear and tear, immediately.
- The driver is responsible for transporting materials properly and ensuring that a load does not exceed the manufacturer's design load capacity. All loads must be properly secured and tied down. Materials should not extend over the sides of the truck.
- The driver and all passengers of a Company vehicle shall wear seat belts at all times while the vehicle is in motion.
- All posted speed limits shall never be exceeded and all local traffic signs shall be obeyed.
- All vehicles shall be parked correctly and/or in designated parking areas. Parked vehicles shall not obstruct other vehicles, roadways, access ways or fire hydrants.

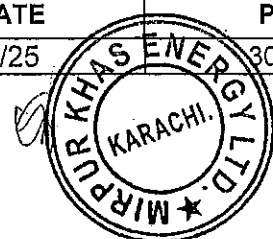
19.0 ACCIDENT / INJURY / DAMAGE REPORTING

19.1 Reports Required

This section applies to the following:

- Fatality.
- Injuries requiring medical attention which result in lost time
- Damage over Rs 50,000 to contractor's plant or equipment
- Damage, in any amount
- Fires Damage and near misses to cranes and heavy equipment

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A preliminary written report shall be submitted within 24 hours followed by a detailed written report.

MEL shall maintain a record of the following;

- Work injuries
- Fires
- Incidents of property damage over RS 50,000
- Motor vehicle accident
- Incidents involving damage to MEL equipment and property
- Damage and near misses to cranes and heavy equipment.

The record shall be available at all times and will be submitted anytime to the local authority if required.

19.2 Accident Investigation

The point of an accident investigation is to prevent recurrence of similar accidents; to determine facts rather than to find faults.

The main reasons for conducting an accident investigation are:

- To find the causes so that similar accidents may be prevented;
- To determine the point at which "unplanned" events took over from the "planned" sequence of events;
- To recommend what corrective action should be taken.

19.2.1 Responsibilities for Investigation

- **Site Managers /Safety Representative**

The Safety supervisor shall report the incident information immediately to Site HSE Manager and MEL Project Head by radio, in person and/or e-mail. Safety supervisor shall complete and forward the initial hard copy Incident Report within 24 hours and finalize those forms within 3 calendar days to Project HSE Dept.

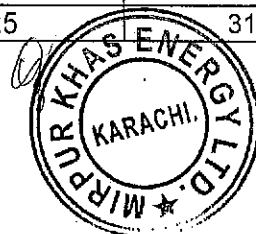
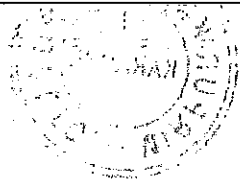
- **Project Head**

The project manager shall review all accident reports to ensure that all the necessary corrective action has been taken and that he has addressed any items that may require action on his part.

19.2.2 Cases to be investigated

Incidents that result in property damage or serious injuries to personnel and hospitalization of two or more employees must be fully investigated and reported. Unless the real cause is known, the hazard cannot be controlled in the future. The

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near-miss incident is equally important from the point of view of prevention and should also be thoroughly investigated.

19.2.3 Accident Investigation Guidelines

The scene of an accident must be left undisturbed until Government Affairs, Industrial Security and the Safety supervisor have conducted their investigation. In some cases the accident site must be rendered safe so as not to contribute to further accidents. However precautions shall be taken to keep the accident scene intact as much as is possible, to assist local police in their investigation. The investigation should include, but not be limited to the following:

- Questioning the man in charge and finding out what was planned.
- The injured man's job or the normal configuration and function of the damaged equipment or plant.
- Questioning the injured man as soon as possible.
- Questioning the witnesses separately as to what they actually saw, not what they think happened.
- Studying the equipment or plant layout and noting any signs of misuse.
- Finding the explanation of any irregularities.
- From the information obtained, establishing the reason why the "unplanned" events took over from those that were "planned".
- Recommending items of corrective action and methods of implementing them to prevent the recurrence of the incident.
- Making a scaled drawing of the accident scene and supplement that with supporting photographs.

19.3 Corrective actions

Include all corrective actions taken or those that should be taken to prevent recurrence of the incident. Include the specific actions to be taken, the employer and personnel responsible for implementing the actions, and a time frame for completion. Be sure the corrective actions address the causes.

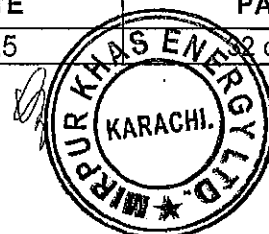
Once the investigation report has been completed, the PH shall hold a review meeting to discuss the incident and provide recommendations. The responsible supervisors shall be assigned to carry out the recommendations, and shall inform the HSE Manager upon successful implementation of all recommended actions.

19.4 Injury and damage reporting.

19.4.1 In line with the Clients guidelines the reporting of injuries and damage to property will be taken up for;

- Fatal injuries
- Injuries resulting in lost time or medical treatment (other than first aid)
- Damage to the properties of MEL (above 50,000 RS)

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- Any magnitude of fire incidents
- Near misses

19.4.2 These records shall be made available for any inspection by the Company at the site. A register covering these aspects will be the source data for these records.

19.4.3 Employees will be encouraged to report on near misses to the supervisor or to the safety officer immediately. Investigation and an action taken report will be prepared. These near misses will be discussed in the Tool Box Talks and in the Safety Committee Meetings.

20.0 FIRE PREVENTION

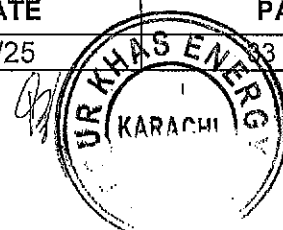
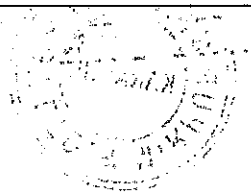
20.1 Fire Prevention General

20.1.1 Through the duration of this Contract, MEL shall be responsible 24 hours per day, 7 days per week for fire protection in its work and operational areas, including offices, tool rooms, and storage areas.

20.1.2 The factors which must be considered before the job starts include site preparation, work permit schedules, types of work permits required and type/quantity of equipment required on-site.

- Consideration should also be given to protecting all equipment against fire, which could be caused by storing it near combustible material and against water or other fire fighting agents that might be used to put out a fire.
- The contractor must also take steps to prevent ignition of construction materials, lubricants, and fuels used in the job itself.
- Beware of indirect sources of ignition: hot welding slag dropped from a height for example, or sparks from a fire under an asphalt kettle are familiar examples of this.
- Proper bonding and grounding techniques shall be used for any operation where static electricity could become an ignition source.
- All flammable liquids must be kept in securely capped metal containers or steel drums on which the contents are clearly marked. Gasoline, acetone, spirits and other volatile liquids with flash points below 32oC (90oF) should be kept in strong metal lockers located in well-ventilated, non-combustible huts or sheds. Drums containing flammable fluids shall be provided with proper bung vents. Flammable storage areas must be securely locked (or fenced), posted with a warning sign "Danger: Flammable Area" and must be located at least 15 meters (50 feet) away from the nearest building or storage area for combustibles. No other materials should be stored with flammable liquids. Flammable gases in cylinders (acetylene, propane, etc.) shall be segregated from other materials, preferably under an open, well-

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ventilated sun shade. Oxidizing gases (oxygen, chlorine, nitrous oxide, etc.) shall be stored separately.

- Extinguishers shall be located within 15 meters of any point on the perimeter of material stored in fuel or combustible materials storage areas. Additionally, these areas shall be identified with signs restricting vehicle access and prohibiting fire ignition sources and smoking.
- All fire prevention/fire fighting equipment shall be inspected monthly to ensure they are in a good working order and replaced if faulty. Records of inspections shall be maintained for review by CEO, as applicable.
- MEL shall establish channels of communication and working arrangements to obtain the assistance of the fire fighting resources from Client.
- Fuel containers shall be of metal and equipped with an air-vent.
- Fuel trucks will be properly grounded when refueling equipment. Equipment shall be switched off during refueling.
- Flow of bagasse towards any hot works going on at the site must be controlled as much as possible by altering or shedding it. Appropriate PPEs (Helmet, Masks, Goggles, Safety Shoes, Gloves etc) should be provided.

20.2 Reporting a Fire

Every fire, including those extinguished by contractor personnel, shall be reported to the Company's CEO/HSE Dept / Project Head. The Fire Protection Unit will inspect the area, to offer suggestions for preventing a recurrence, and to ensure the MEL has re-established his fire fighting capability by recharging extinguishers or replacing equipment. The emergency telephone number used for reporting a fire or any emergency that requires Client assistance is required. The MEL must ensure that the number given is posted at all telephones and that instructions are placed indicating how to report the emergency correctly.

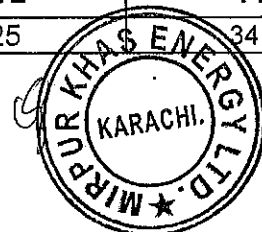
20.3 Fire Watch

The MEL shall furnish Fire watch personnel for all cutting, burning and welding, and other open flame operations. The Fire watches personnel's will be properly trained and equipped with the proper fire fighting equipment. The Fire-watch will be responsible to watch for fires, prevent fires, put fires out, and give the alarm. Each Fire-watch person will be responsible for a maximum area described by an eight-meter circle on a horizontal plane. All open flame operations will be within the responsibility area of a Fire-watch. Fire-watchers will wear an orange reflective vest with "Fire Watch" printed on the back for easy identification.

21.0 WELFARE FACILITY

22.1 Drinking Water

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- MEL will provide an adequate supply of potable water in all its work areas daily and test water supply weekly.
- Portable containers for drinking water shall be tightly closed and equipped with a tap. Water shall not be dipped from containers.
- Drinking water stations/containers shall be clearly labeled as to the nature of its contents, and shall not be used for any other purpose.
- Drinking water containers shall not be opened in the field by anyone other than employees designated to service and maintain the containers.
- Non-potable water outlets shall be clearly labeled as being unsafe for drinking, or washing purposes.
- Portable water containers shall be cleaned weekly, using bleach wash and baking soda rinse.
- Single use drinking containers shall be provided at each water container. Adequate trash containers shall be provided to dump the single use drinking containers. The use of a common drinking cup will not be permitted. Personnel are not permitted to drink directly from the container.

21.2 Toilets

- Toilet facilities shall be provided for employees to the ratio of one toilet per 15 employees.
- All job site toilet facilities shall be serviced and cleaned on a regular basis and frequently as necessary determined by the amount of use and season of the year but not less than once per day.
- Portable toilets/ permanent toilets on the project shall be strategically located so as to provide adequate coverage for all active work areas. In multi-story structures, no more than two (2) floors will separate each toilet.
- Hand washing stations should be provided.

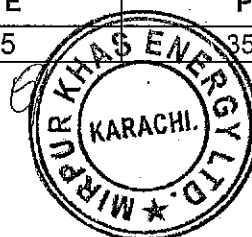
21.3 Lunch / Break Areas

- Employees shall take breaks and eat lunch in designated areas only. These areas shall be free from hazardous materials or other possible contaminants.
- Lunch and break areas shall be removed from active work areas where employees would be exposed to on-going work while eating lunch or taking a break.
- Contractor shall ensure all trash, debris and food residues are cleaned up at the end of the break.
- The lunch and break areas shall be shaded against sun and sandstorms. The locations and requirement of such facility shall be approved by CEO/ HSE Dept.

22.0 HOUSEKEEPING

- During the course of construction, all debris and scrap material shall be kept away from the work area. Work areas shall be cleaned at the end of each shift.
- Containers shall be provided by Contractor for the collection and separation of waste, trash, oily and used rags and other refuse. Metal (Dumpster type) containers must be used and emptied promptly.

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- Garbage and other waste shall be disposed of at frequent and regular intervals in a manner approved by Owner.
- Contractor shall notify Owner of any hazardous waste it will generate during performance of the Work. Contractor has the direct responsibility of maintaining proper storage of these wastes while on site and will verify to Company in writing that the wastes have been disposed of in a legal manner.
- Contractor shall not pour, bury, burn, not in any way dispose of a chemical on the work jobsite without the permission of the Company.
- Materials and supplies shall be stored in locations, which will not block access-ways, and arranged to permit easy cleaning of the area. In areas where equipment might drip oil or cause other damage to the floor surface, a protective cover of heavy gauge, flame resistant oil-proof sheeting shall be provided between the equipment and the floor surface sheeting so that no oil or grease contacts the concrete. This requirement is applicable to both finished and unfinished floors.
- All hoses, cables, extension cords, and similar materials shall be located, arranged, and grouped so that they will not block any access-way and will permit easy cleaning and maintenance.

23.0 JOB SITE INSPECTION

24.1 General Requirements

In addition to the hazard controls specified in this document, Project Activity Self-Assessment Checklists are contained in Attachment for typical construction activities. The Project-Activity Self-Assessment Checklists are based upon minimum regulatory compliance and some site-specific requirements may be more stringent. The MEL shall use these checklists to assess the adequacy of site-specific safety requirements and determine if employees will be safe. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. The self-assessment checklists, including documented corrective actions, shall be made part of the permanent project records and maintained by the HSE Supervisor. The self-assessment checklists will be used by the Supervisors, Engineers, Skilled personnel and Safety Officers in evaluating the MEL compliance on site. If hazardous conditions exist or are apparent during the self-assessment, immediately notify the employees in the area and do not continue work in that area.

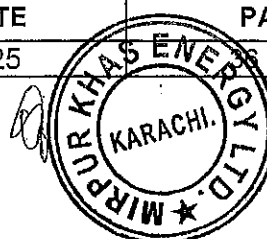
23.2 Deficiency Tracking System

23.2.1 Behavioural Base Safety

MEL believes in behavioral monitoring procedure. Behavioral observation will be done by all Managers, engineers and Supervisors. They will make observation of Tools and Equipments, unsafe position, unsafe location, JSA, Barricades, permits, etc on daily basis. Both good behaviors and questionable or unsafe behaviors will be annotated on the form and discussed with the observed worker(s) and his foreman. Any unsafe behavior or acts observed will be documented in writing to the project Head for action.

23.2.2 Safety Audit

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Site HSE Manager & supervisor will regularly conduct a daily Safety Audit to evaluate company safety performance and discuss with project Head/ Manager and Supervisor to make corrective action for those unsafe work practices, equipment condition, tools condition, PPE usage, work permit compliance, housekeeping, etc. Inspection shall be documented using appropriate checklist.

23.2.3 Self Assessment Checklists

All Site supervisors, Engineers, skilled personnel and safety supervisors will complete self assessment on daily basis by using checklist form. Any item which is showing risk must be explained on the last sheet of the checklist, and followed up for corrective action. These risk assessment checklists once completed and signed by the inspector, reviewed with the applicable supervisor and / or employee and signed by the project manager will become a permanent record of inspection and part of the project files.

24.0 EMERGENCY PLANNING & RESPONSE

24.1 Purpose

The purpose of this procedure is to provide detailed guidance to all Emergency Response Members to effectively control an emergency situation effectively throughout the project. Specific requirements, roles and responsibilities, and action plans are documented in this plan to minimize the damages of an emergency incident.

24.2 Definitions

- **Emergency Incident**

An unexpected and undesirable event which must be dealt with at once. This may include any kind of event that may result in injury of personnel, damage to project facilities, infrastructure or damage to environment, involving fire and explosion, spillage of toxic, combustible or corrosive chemicals release of flammable or toxic gas.

- **Major Incident**

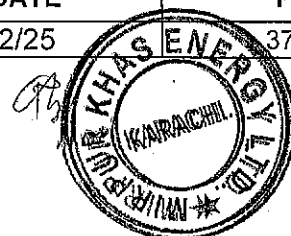
A Major Incident involves serious property damage, equipment failure, fire, fatal or personnel injury, catastrophic incident e.g. storm, flood, earthquake including terrorism and may require assistance of external emergency response teams to control the impact of an explosion, demolition, severe or life threatening injury, or illness to one or more persons.

- **Minor Incident**

A Minor Incident involves only internal emergency response to control the impact (such as a small fire, small flange leak, first aid injury etc.)

24.3 Emergency preparedness training

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The emergency response plan will be reviewed during the employee orientation and occasionally during site safety briefings. The briefings should include:

Emergency procedures for fires, explosions, chemical and vapour releases, personnel injuries, and suspected over exposure as they apply to the site Location of onsite emergency equipment and supplies of clean water Contact information for on site Emergency Medical Treatment. Local emergency contacts, evacuation routes, and assembly points Site communication and location of phone or radio nearest to the site Names of onsite personnel trained in first-aid and CPR.

24.4 Emergency evacuation procedure

All the MEL personnel are trained on emergency evacuation procedure. They will be further trained in line with the client's requirements thru the induction programs and emergency drills. In line with the client's guidelines for emergency procedures.

- a) On hearing the "Stop Work Alarm" the supervisor will ensure immediate stoppage of work.
- b) All equipments will be shut down and all electrical equipments will be isolated.
- c) All vehicles will be parked on the side of the road, shut down and the keys will be left inside the vehicle. The driver of the vehicle will reach the assembly point.
- d) All workmen will be lead to the nearest "Safe Assembly point" following the cross wind direction.
- e) Head count / roll call will be carried out by the Project Engineer and by the Safety Supervisors for any missing person. The account will be given to the client on demand.

25.0 HAZARD MATERIAL AND WASTE MANAGEMENT

Effective information and training on hazardous chemicals shall be given to project employees by their employer at the time of initial assignment and/or whenever a new physical or health hazard the employees have not been previously trained about is introduced into their work area.

All onsite hazardous chemicals shall have an accompanying MSDS available to employees for reference.

The MEL shall submit a copy of the MSDS sheet to the HSE Dept for all onsite hazardous chemicals and when a new hazardous chemical is introduced to the project.

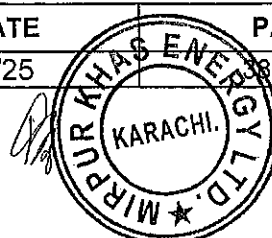
The HSE Supervisor will complete the Chemical Inventory to verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to personnel are implemented.

MEL shall provide documentation to verify that they have provided adequate employee training for the onsite hazardous chemicals.

All chemical containers shall be labelled with the identity of the chemical and with hazard warnings. All hazardous materials will be properly stored. The Safety Supervisor will give consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

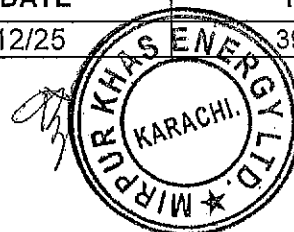
26.0 IONIZING RADIATION

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- MEL shall appoint qualified employee as Radiation Coordinator. The person shall be responsible for aspects of work involving the storage, the handling, the transportation and the use of ionizing sources on the project and ensure safe work practices and procedures are followed by MEL employees. All ionizing and radioisotope source and x-ray work will be done with the coordination of other project participants working on the project.
- Radiographers are expected to safely use radiation sources in the course of their work and must be in possession of a valid Permit to Use Material/Equipment Producing Ionizing Radiation" before they can work with a radioactive source.
- Contractor shall ensure all personnel that are occupationally exposed to ionizing radiation, are subject to a regular medical check and continual medical monitoring, a copy of such medical report must be kept on record and made available for inspection to authorities and HSE Dept.
- Unshielded sources are kept at a sufficient distance from personnel so as not to pose a health hazard to them.
- Time is a useful method of protection because high dose rates can be accepted over very short periods of time. However, the cumulative dose must remain at acceptable limits.
- Non-radiation workers should not receive more than those dose limits.
- MEL shall obtain an approved permit from for all work involving ionizing radiation occurring by natural decay of radioisotopes (nuclides) and /or x-rays as produced by electrical means from portable or static equipment. Permits shall be submitted 24 hours in advance for approval with an area plot plan indicating the area the work is to be performed.
- Contractor shall inspect prior to the start of ionizing radiation Work to ensure:
 - ❖ People that are performing the work are licensed and have valid certification of the Pakistan Government.
 - ❖ Each person involved in the work has a monitoring film badge and a pocket dosimeter.
 - ❖ A survey meter with audible and visual alarms is in the area for radiation area monitoring and shall accompany the source each time.
 - ❖ An accurate accounting system is kept for each source coming onto the project and shall include the serial number, receipt date, decay chart and projector or transit container used.
 - ❖ The work areas in which ionizing radiation work is to be performed are barricaded, warning signs and lights posted, perimeter guards posted and all workers removed from the area before work starts.

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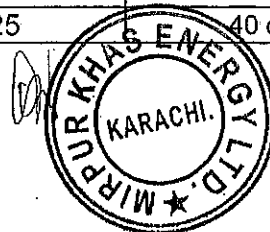
❖ A safe access and egress will provided to the work location with adequate lighting.

- MEL shall ensure all vehicles transporting ionizing and radioisotope sources onto the project are fitted with yellow revolving lights on rooftop and are marked "NDT Radiography" on both sides and rear end of the vehicle.

27.0 ABRASIVE BLASTING AND PAINTING

- All operators of abrasive blast cleaners shall be instructed and trained in the correct use and hazards associated with abrasive blast cleaning equipment and abrasive materials.
- Abrasive blast cleaning equipment may only be operated with all protective guards and controls in place and working properly, and in accordance with manufacturer's recommendations.
- Areas where abrasive blast cleaning is in progress shall be suitably barricaded to keep unauthorized personnel out of the hazardous area, or otherwise protected. Warning signs shall be posted in hazardous areas with suitable warnings of the potential dangers (e.g., "No Entry-Abrasive Blast Cleaning in Progress").
- Breathing air shall meet the requirements and be tested in accordance with GI 1780.001, Atmosphere- Supplying Respirators.
- Abrasive blast cleaners shall also wear personal protective equipment that includes safety goggles, leather or neoprene gloves, leather or neoprene apron, hearing protection, safety shoes and coveralls.
- Abrasive blast cleaners shall wear an air supplied hood, type "CE" supplied-air respirator, approved for abrasive blast cleaning by the National Institute for Occupational Safety and Health (NIOSH) of the United States Department of Health and Human Services, and the Mine Safety and Health Administration (MSHA)
- Hoses and nozzle fittings shall be securely fixed to prevent unplanned disengagement during abrasive blast cleaning operations.
- Abrasive blast cleaning equipment shall be designed to automatically shut off the flow of abrasive and propellant, if for any reason the operator releases the control switch.
- All electrical equipment such as switches, panel boards, electrical motors and associated equipment must be de-energized before spray painting to eliminate explosion hazards. Fire extinguishers should be located at the work. Work areas should be kept as clean as practically possible.
- The use and storage of flammable paints and solvents shall be kept to restricted areas and these areas should be suitably marked with the appropriate warning signs. Flammable paints should be kept in a special building or in a sun shelter.

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28.0 SAFETY MEETINGS

29.1 Project Employee Orientation

The employee orientation shall include PPE Training, Review emergency evacuation procedure, Fall protection Training, Crane and rigging Training, Blood born pathogen raining, Scaffold Training, Stair and Ladder Safety Training, First Aid Training etc.

29.2 Pre Task Safety Meeting

Each day, the onsite supervisors shall hold informal safety training with each member of their crew. Information discussed and training performed shall pertain to current project activities and scope of work. This training shall be documented by using PTSM checklist.

29.3 Tool Box Talk

Tool Box Talk will be conducted every day for maximum of 15 minutes. This will precisely talk about the hazards of the job planned, risk associated with and the control measures in place. The talk will be carried out by the supervisor and assisted by site safety officer. The talk will be in English/Urdu and at least in one of a language covering majority of the work force. Signing sheet of Tool Box Talk shall be documented in Project file.

29.4 Safety Committee Meeting

Safety Committee Meeting will be conducted every week on a fixed day, fixed time, Such meetings will follow the minimum agenda, recording of the minutes & circulating to the concerned for necessary action. The project Head of MEL shall chair the meetings, the Site safety manager shall be the coordinator and the committee will comprise of supervisors and workforce in addition to the above. The project Head shall be responsible for providing resources for implementing the recommendations of the meetings.

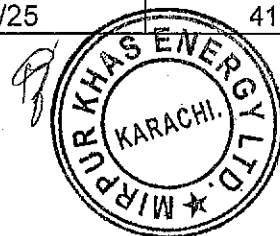
29.0 NIGHT WORK

- In addition to the existing plant lighting additional lighting would be provided, if required.
- When traffic control is required employee will be provided with reflecting type vest.
- All employees working in a high traffic area will be provided with reflective vest.
- The night shift Engineers will be the emergency controller.
- Critical work such as confined space entry will be done under strict supervision.
- Adequate warning signs of reflective type / safety barricades will be used.
- Stand by generators and emergency vehicles will be arranged as per the contractual Terms and conditions

30.0 PRESSURE TEST

- A work permit shall be issued prior to commencement of hydrostatic test operations.

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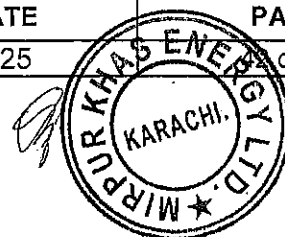


- Where isolation valves are used to contain test pressures, they must be of adequate rating for the pressure to be encountered.
- Prior to testing, investigations shall be carried out to verify whether or not temporary restraints are required to restrict the movement of piping and joints during testing; when necessary, adequate restraints shall be provided.
- Pressure relief valve(s) shall be used to prevent over pressuring of the equipment.
- Only calibrated test gauges shall be used and they should be mounted in the upright position.
- A system under test shall be depressurized (with the exception of pressure due to a liquid head) before any work is done to stop leaks or repair weakness, including the tightening of bolts. In tightness tests, bolts may be tightened without depressurizing, if specifically approved in the written test procedure.

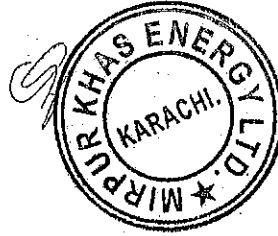
31.0 DEMOLITION

- Before any demolition work is started, MEL assigns a competent Person in writing as the person responsible for all work on site. The man appointed shall be experienced in demolition operations. His duties will include the direct supervision of the work force, ensuring that work permit requirements are met, liaison with other contractors working in the general area and with operators and construction or maintenance engineers.
- All utility services such as electricity, gas, and water must be shut off and the main supplies disconnected outside the line of the demolition work.
- Adjacent structures and equipments shall be protected from demolition debris that can likely cause hazards to the general public. Also, bracing must be installed to insure stability of adjacent structures.
- Barricades must be erected around the work area. Signs bearing the words "Danger Demolition in Progress" in English and Urdu must be erected at each approach to the barricade.
- It should be remembered that the safest and most efficient method is to start at the top and dismantle in the reverse order of construction. There are, however, cases where such a method is impractical or uneconomical and where other methods have to be considered.
- A safe means of access to and egress from all working places must be provided. Work places and the areas around ladders and stairways must be kept clear of material and debris.
- All steel construction should be demolished column length by column length and tier by tier. A structural member being removed must not be under any stress other than its own weight.

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Members being cut or dismantled should be chained or lashed in place to prevent uncontrolled swinging or dropping.



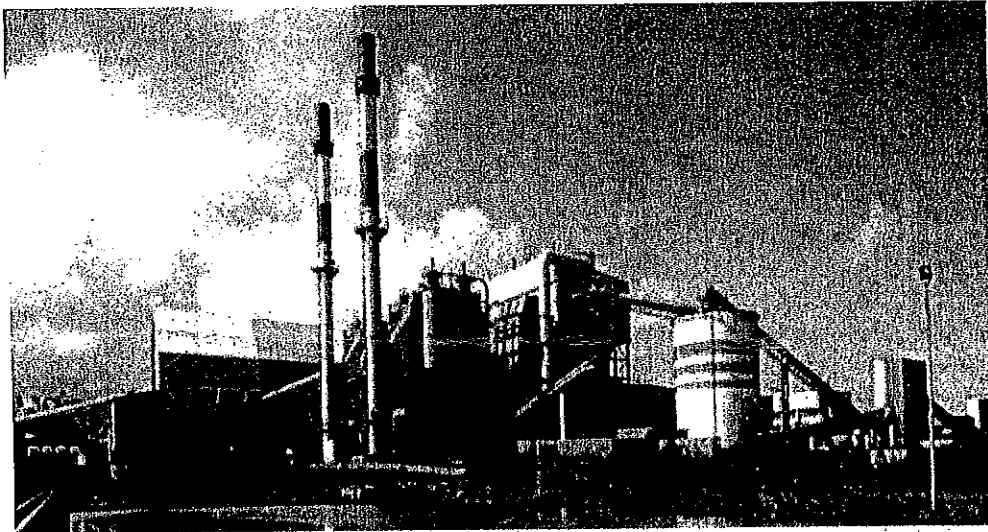
Mirpurkhas

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INTERCONNECTION STUDY

For
**26 MW Cogen Power Plant, Mirpurkhas
Energy Limited, District Mirpurkhas, Sindh**



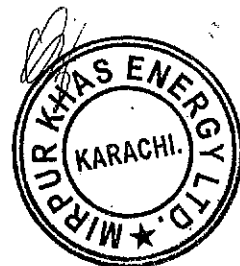
*Draft Report
(December 2016)*

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Executive Summary

- ❖ The Draft Report for interconnection of 26 MW Mirpurkhas Energy Limited (MEL) Bagasse based Cogeneration Power Plant with HESCO grid system is submitted herewith.
- ❖ Mirpurkhas Energy Limited would like to go for high pressure cogeneration with the aim of exporting a maximum of 23.50 MW electrical power to the national grid.
- ❖ The study objective, approach and methodology have been described and the plant's data received from the Client is validated. The network around Mirpurkhas Energy Limited (referred to as MEL in the remainder of the report) at 132 kV and 11 kV has been modeled as shown in Appendix-B (Sketch-1).
- ❖ The nearest HESCO grid facility available for interconnection to MEL is Mirpurkhas-2 132 kV Grid Station and Samaro 132 kV Grid Station.
- ❖ Keeping in view the location of Power Project, it is proposed to connect Mirpurkhas Energy Limited via looping In-Out of the existing Transmission Line from 132 kV Samaro grid station to Mirpurkhas-2 132 kV grid station. The looping distance as confirmed from site visit would be 2 km and the conductor used would be Lynx. The scheme is shown in Sketch-2 in Appendix-B.
- ❖ MEL would generate power at 11 kV voltage level from where it is stepped-up to 132 kV using two 132/11 kV transformers with rating of 31.5/40 MVA.
- ❖ The proposed scheme would require two 132 kV line bays at the 132 kV substation of MEL for the connection to 132 kV Samaro grid station and Mirpurkhas-2 132 kV grid station. Furthermore it would also require two transformer bays for the connection of two 132/11 kV transformers with rating of 31.5/40 MVA.
- ❖ With the gross capacity of 26 MW, the spillover from MEL would be 23.50 MW in Off-Season and 20.50 MW in the Crushing Season.
- ❖ In view of planned COD of MEL in September 2018, the above proposed interconnection scheme has been tested for steady state conditions through detailed load flow studies for the peak conditions of
 - January 2019 for maximum thermal power dispatches in the grid during the Crushing Season for MEL.



- o September 2019 for maximum hydropower dispatches in the grid during the off-season for MEL.

The system conditions of normal and N-1 contingency have been studied to meet the reliability criteria of NEPRA Grid Code.

- ❖ The proposed scheme of interconnection has also been tested for the extended term scenario of peak load conditions of the year 2021 for steady state conditions.
- ❖ Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the spillover of up to 23.50 MW power of the Plant under normal as well as contingency conditions.
- ❖ The short circuit analysis has been carried out to calculate maximum fault levels at MEL and the substations of 132 kV in its vicinity. We find that the fault currents for the proposed scheme are within the rated short circuit capacities of switchgear installed at these substations. There are no violations of exceeding the rating of the equipment due to contribution of fault current from MEL.
- ❖ The maximum short circuit levels of MEL 132 kV is 8.99 kA and 9.17 kA for 3-phase and 1-phase faults respectively for the Year 2019 and 9.37 kA and 9.47 kA for 3-phase and 1-phase faults respectively for the Year 2021. It would be advisable to go for standard size switchgear of short circuit rating of 40 kA. It would provide large margin for any future increase in short circuit levels due to future generation additions and network reinforcements in this area.
- ❖ The dynamic stability analysis of proposed scheme of interconnection has been carried out for January 2019. The stability check for the worst case of three phase fault right on the 132 kV bus bar of MEL substation followed by the final trip of one 132 kV circuit emanating from this substation, has been performed for fault clearing of 5 (100 ms) and 9 cycles (180 ms), in case of stuck breaker, as understood to be the normal fault clearing time of 132 kV protection system. The stability of system for far end faults of 3-phase occurring at 132 kV bus bar have also been checked. The proposed scheme successfully passed the dynamic stability checks for near and far faults for the most stringent cases. The system is found strong enough to stay stable and recovered with fast damping.
- ❖ The proposed scheme of interconnection has no technical constraints or problems, it fulfills all the criteria of reliability and stability under steady state load flow,



contingency load flows, short circuit currents and dynamic/transient conditions;
and is therefore recommended to be adopted.



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Appendices

Appendix –A:

- NTDC Generation Plan
- NTDC Transmission Plan
- NTDC Load Forecast
- Technical Data provided by the Sponsor

Appendix –B:

- Sketches for Chapter-4

Appendix –C: Plotted Results of Load Flow for Chapter – 5

Appendix –D: Results of Short Circuit Analysis for Chapter – 6

Appendix –E: Plotted Results of Stability Analysis for Chapter – 7

Appendix –F: Dynamic Data for Mirpurkhas Energy Limited



1. Introduction

1.1 Background

Mirpurkhas Energy Limited PP would like to go for high pressure cogeneration with the aim of exporting spillover power to the National Grid. The electricity generated from this project would be supplied to the grid system of HESCO through 132 kV grids available in the vicinity of this project. The nearest grid facility is Mirpurkhas 132 kV Grid Station and Samaro 132 kV Grid Station as shown in Sketch-1 in Appendix-B.

1.2 Objectives

The overall objective of the Study is to evolve an interconnection scheme between MEL and HESCO network, for stable and reliable evacuation of the electrical power generated from this plant, fulfilling N-1 reliability criteria. The specific objectives of this report are:

1. To develop scheme of interconnections at 132 kV for which right of way (ROW) and space at the terminal substations would be available.
2. To determine the performance of interconnection scheme during steady state conditions of system, normal and N-1 contingency, through load-flow analysis.
3. To check if the contribution of fault current from this new plant increases the fault levels at the adjoining substations at 132 kV voltage levels to be within the rating of equipment of these substations, and also determine the short circuit ratings of the proposed equipment of the substation at MEL.
4. To check if the interconnection withstands dynamic stability criteria of post fault recovery with good damping.



1.3 Planning Criteria

The planning criteria required to be fulfilled by the proposed interconnection is as follows:

Steady State:

Voltage	$\pm 5 \%$, Normal Operating Condition
	$\pm 10 \%$, Contingency Conditions
Frequency	50 Hz Nominal
	49.8 Hz to 50.2 Hz variation in steady state
	49.4 - 50.5Hz, Min/Max Contingency Freq. Band

Short Circuit:

Substation Equipment Rating for 132 kV should be 31.5 kA or 40 kA.

Dynamic/Transient:

The system should revert back to normal condition after dying out of transients without losing synchronism with good damping after permanent three-phase fault on any primary transmission element; including: transmission circuit, substation bus section, transformer, or circuit breaker. It is assumed that such a fault shall be cleared by the associated circuit breaker action in 5 cycles.

In case of failure of primary protection (stuck breaker case), the total fault clearing time from the instant of initiation of fault current to the complete interruption of current to isolate the faulted element, including the primary protection plus the backup protection to operate and isolate the fault, is equal to 180 ms (9 cycles) for 132 kV and higher voltage levels.



2. Technical Data

The number of generating units at MEL is one. The following data have been provided by the Client:

2.1 MEL data

Generator data:

Gross capacity of power plant	= $1 \times 26 = 26$ MW
Lump sum MVA capacity	= $1 \times 33.65 = 33.65$ MVA
Generating Voltage	= 11 kV
Power factor	= 0.80 lagging

Crushing Season:

Load + Auxiliary Consumption	= 5.50 MW
Spillover to the Grid	= 20.50 MW

Off-Season:

Load + Auxiliary Consumption	= 2.50 MW
Spillover to the Grid	= 23.50 MW

GSU Transformer	= 31.5/40 MVA (x2)
GSU Transformer reactance	= 12.5 %

2.2 Network data

The latest Generation Expansion Plan and Load Forecast has been used as provided by NTDC and is shown in Appendix-A.

The 132 kV network in the area near MEL are as shown in Sketches in Appendix-B. The system data of HESCO has been used as already available with PPI.



3. Study Approach and Methodology

3.1 Understanding of the Problem

Mirpurkhas Energy Limited PP would like to go for high pressure cogeneration with the aim of exporting a maximum of 23.50 MW supply to the grid during the Off-Season and 20.50 MW in Crushing Season. The proposed Power Project is going to be embedded in the transmission network of HESCO through this nearest available 132 kV network.

The adequacy of HESCO network of 132 kV in and around the proposed site of MEL has been investigated in this study for absorbing and transmitting this power fulfilling the reliability criteria.

3.2 Approach to the problem

The consultant has applied the following approaches to the problem:

- A base case network model has been prepared for January 2019 (Crushing Season) and September 2019 (Off-Season) after the commissioning of MEL in September 2018, comprising all 500 kV, 220 kV and 132 kV system, envisaging the load forecast, the generation additions and transmission expansions for that year particularly in HESCO.
- Month of January 2019 and September 2019, while representing Crushing Season and Off-Season respectively, also represent low water and high water conditions respectively in the grid system. Thus both the high water and low water flow patterns can be observed allowing us to judge the maximum impact of the plant on the transmission system in its vicinity. In addition, case for extended term scenario of the year 2021 has also been studied.
- Interconnection scheme without any physical constraints, like right of way or availability of space in the terminal substations, have been identified.
- Perform technical system studies for peak load conditions to confirm technical feasibility of the interconnections. The scheme will be subjected to standard analysis like load flow, short circuit, and transient stability study to check the strength of the machines and the proposed interconnection scheme under disturbed conditions.



- Determine the relevant equipment for the proposed technically feasible scheme.
- Recommend the technically most feasible scheme of interconnection.



4. Development of Scheme of Interconnection

4.1 The Existing and Ongoing Network

26 MW Bagasse based cogeneration PP, Mirpurkhas Energy Limited is located in District Mirpurkhas embedded in the distribution network of HESCO. The existing 132 kV network available around MEL is shown in Sketch-1 in Appendix-B. The nearest interconnection facilities of HESCO at time of commissioning of MEL would be as follows:

- 132 kV Mirpurkhas Grid Station
- 132 kV Samaro Grid Station

The system around MEL has another co-generation power plant in the vicinity i.e. Mehran Sugar Mills PP. There is a strong 220 kV network in the vicinity connecting Hala Road 220/132 kV grid station with Jamshoro 220 kV, T.M.Khan 220 kV and Mirpurkhas 220 kV substations. A strong system helps in stable operation of a power plant.

4.2 The Scheme of Interconnection of MEL

Keeping in view of the above mentioned 132 kV network available in the vicinity of the site of the MEL, the interconnection scheme for MEL has been developed. According to the new scheme, it is proposed to connect Mirpurkhas Energy Limited via looping In-Out of the existing Transmission Line from 132 kV Mirpurkhas grid station to Samaro 132 kV grid station. The looping distance as confirmed from site visit would be 2 km and the conductor used would be Lynx. The scheme is shown in Sketch-2 in Appendix-B. The network of MEL has been modeled at 132 kV and 11 kV.

5. Detailed Load Flow Studies

5.1 Peak Case Load Flow January 2019, without MEL

A base case has been developed for the peak load of January 2019 using the network data of NTDC and HESCO available with PPI, after updating with latest load forecast and expansion plan of NTDC and HESCO. The peak load of the year 2018-19 for HESCO has been modeled as per the latest PMS Demand forecast obtained from NTDC.

The results of load flow for this base case are plotted in Exhibit 0.0 of Appendix-C. The system plotted in this Exhibit comprises of 132 kV network feeding Hala Road, Samaro, Mir Wahg, Mirpurkhas and the surrounding areas.

The load flow results show that the power flows on all the circuits are within their normal rating. The voltage profile of these surrounding substations is also within normal limits.

For N-1 contingency conditions we have performed the following cases

Exhibit - 0.1	Trip Mirpurkhas to Mirpurkhas-2 132 kV Single Circuit
Exhibit - 0.2	Trip Mirpurkhas-2 to Samaro 132 kV Single Circuit
Exhibit - 0.3	Trip Mirpurkhas to Samaro 132 kV Single Circuit
Exhibit - 0.4	Trip Mirpurkhas to Mir Wahg 132 kV Single Circuit
Exhibit - 0.5	Trip Mehran to Mirpurkhas 132 kV Single Circuit
Exhibit - 0.6	Trip T.A.Yar to Mirpurkhas 132 kV Single Circuit

We see that in all the cases the power flows on all circuits remain within their rated limit. Also the bus voltages are within the acceptable operating range.

5.2 Peak Case Load Flow January 2019, with MEL in Crushing Season

The scheme of interconnection modeled in the load flow for MEL is as described in Chapter-4.

Load flow studies have been carried out for January 2019 because it represents the maximum thermal power dispatch conditions in the grid during the Crushing Season



condition for MEL. Thus the loading on the lines in the vicinity of MEL will be maximum, allowing us to judge the maximum impact of the plant on the transmission system in its vicinity. The results of load flow with MEL interconnected as per proposed scheme are shown in Appendix-C.

The results of Normal case of Peak January 2019 are plotted in Exhibit 1.0. We find no capacity constraints on 132 kV circuits under normal conditions i.e. without any outages of circuits.

The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of $\pm 5\%$ off the nominal.

N-1 contingency analysis has been carried out and the plotted results are attached in Appendix – C as follows;

Exhibit – 1.1	Trip Mirpurkhas Sugar Mill 132/11 kV Transformer
Exhibit – 1.2	Trip Mirpurkhas Sugar Mill to Mirpurkhas-2 132 kV Single Circuit
Exhibit – 1.3	Trip Mirpurkhas to Mirpurkhas-2 132 kV Single Circuit
Exhibit – 1.4	Trip Mirpurkhas Sugar Mill to Samaro 132 kV Single Circuit
Exhibit – 1.5	Trip Mirpurkhas to Samaro 132 kV Single Circuit
Exhibit – 1.6	Trip Mirpurkhas to Mir Wahg 132 kV Single Circuit
Exhibit – 1.7	Trip Mehran to Mirpurkhas 132 kV Single Circuit
Exhibit – 1.8	Trip Mirpurkhas to T.A.Yar 132 kV Single Circuit

We see that in all the contingency cases, in the event of outage of any circuit, the intact circuits remain within the rated capacity.

Also the bus bar voltages are well within the permissible limits in all the contingency events.

5.3 Peak Case Load Flow September 2019, with MEL in Off-Season

The scheme of interconnection modeled in the load flow for MEL is as described in Chapter-4.



Load flow studies have been carried out for September because it represents the maximum hydropower dispatch conditions in the grid during the Off-Season for MEL. The results of load flow with MEL interconnected as per proposed scheme are shown in Appendix-C.

The results of Normal case of Peak September 2019 are plotted in Exhibit 2.0. We find no capacity constraints on 132 kV circuits under normal conditions i.e. without any outages of circuits.

The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of $\pm 5\%$ off the nominal.

N-1 contingency analysis has been carried out and the plotted results are attached in Appendix – C as follows;

Exhibit – 2.1	Trip Mirpurkhas Sugar Mill 132/11 kV Transformer
Exhibit – 2.2	Trip Mirpurkhas Sugar Mill to Mirpurkhas-2 132 kV Single Circuit
Exhibit – 2.3	Trip Mirpurkhas to Mirpurkhas-2 132 kV Single Circuit
Exhibit – 2.4	Trip Mirpurkhas Sugar Mill to Samaro 132 kV Single Circuit
Exhibit – 2.5	Trip Mirpurkhas to Samaro 132 kV Single Circuit
Exhibit – 2.6	Trip Mirpurkhas to Mir Wahg 132 kV Single Circuit
Exhibit – 2.7	Trip Mehran to Mirpurkhas 132 kV Single Circuit
Exhibit – 2.8	Trip Mirpurkhas to T.A.Yar 132 kV Single Circuit

We see that in all the contingency cases, in the event of outage of any circuit, the intact circuits remain within the rated capacity.

Also the bus bar voltages are well within the permissible limits in all the contingency events.

5.4 Peak Load Case 2021: Extended Term Scenario

We have also studied the future scenario of Year 2021 to assess the impact of the plant in the extended term.



The results of Normal case of Peak 2021 are plotted in Exhibit 3.0. The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of $\pm 5\%$ off the nominal.

We find no capacity constraints on 132 kV circuits under normal conditions i.e. without any outages of circuits.

N-1 contingency analysis has been carried out and the plotted results are attached in Appendix – C as follows;

Exhibit – 3.1	Trip Mirpurkhas Sugar Mill 132/11 kV Transformer
Exhibit – 3.2	Trip Mirpurkhas Sugar Mill to Mirpurkhas-2 132 kV Single Circuit
Exhibit – 3.3	Trip Mirpurkhas to Mirpurkhas-2 132 kV Single Circuit
Exhibit – 3.4	Trip Mirpurkhas Sugar Mill to Samaro 132 kV Single Circuit
Exhibit – 3.5	Trip Mirpurkhas to Samaro 132 kV Single Circuit
Exhibit – 3.6	Trip Mirpurkhas to Mir Wahg 132 kV Single Circuit
Exhibit – 3.7	Trip Mehran to Mirpurkhas 132 kV Single Circuit
Exhibit – 3.8	Trip Mirpurkhas to T.A.Yar 132 kV Single Circuit

The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of $\pm 10\%$ off the nominal for contingency conditions' criteria

We find that there are no capacity constraints in the proposed connectivity scheme of MEL.

5.5 Conclusion of Load Flow Analysis

The proposed interconnection scheme of MEL is adequate to evacuate the spillover electrical power from MEL under normal and contingency conditions tested for peak load conditions of January 2019, September 2019 and extended term scenario of the Year 2021. In all the normal and contingency cases, we find that the loading on the circuits remain within the rated capacity. Also the bus bar voltages are well within the permissible limits in all the normal and contingency events. Hence the proposed interconnection scheme of MEL has no constraints according to the Load Flow Analysis.



6. Short Circuit Analysis

6.1 Methodology and Assumptions

The methodology of IEC 909 has been applied in all short circuit analyses in this report for which provision is available in the PSS/E software used for these studies.

The maximum fault currents have been calculated with the following assumptions under IEC 909:

- Set tap ratios to unity
- Set line charging to zero
- Set shunts to zero in positive sequence
- Desired voltage magnitude at bus bars set equal to 1.10 P.U. i.e. 10 % higher than nominal, which is the maximum permissible voltage under contingency condition.

For evaluation of maximum short circuit levels we have assumed contribution in the fault currents from all the installed generation capacity of hydel, thermal and nuclear plants in the system in the year 2019 i.e. all the generating units have been assumed on-bar in fault calculation's simulations.

The assumptions about the generator and the transformers data are the same as mentioned in Ch.2 of this report.

6.2 Fault Current Calculations without MEL – Year 2019

In order to assess the short circuit strength of the network of 132 kV without MEL for the grid of HESCO in the vicinity of the site of the Plant, fault currents have been calculated for balanced three-phase and unbalanced single-phase short circuit conditions. These levels will give us the idea of the fault levels without MEL and later on how much the contribution of fault current from MEL may add to the existing levels.

The results are attached in Appendix – D.

The short circuit levels have been calculated and plotted on the bus bars of 132 kV of substations lying in the electrical vicinity of our area of interest i.e. Mirpurkhas, Samaro, Mir Wah Gurchani, Sultanabad and the surrounding bus bars and are shown plotted in the Exhibit 4.0 attached in Appendix-D. Both 3-phase and 1-phase fault



currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-D for the 132 kV bus bars of our interest. The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 6.1. We see that the maximum fault currents do not exceed the short circuit ratings of the equipment at these 132 kV substations which normally are 20 kA, 25 kA or 31.5 kA for older substations and 40 kA for new substations.

Table-6.1
Maximum Short Circuit Levels without MEL - Year 2019

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
T. A. Yar 132 kV	9.62	9.28
Sultanabad 132 kV	11.51	11.03
Mirpurkhas 132 kV	13.75	14.57
Mirpurkhas-2 132 kV	9.26	8.87
Mir Wah Gurchani 132 kV	6.46	5.87
Mehran 132 kV	6.90	5.10
Samaro 132 kV	6.15	6.39

6.3 Fault Current Calculations with MEL – Year 2019

Fault currents have been calculated for the electrical interconnection of proposed scheme. Fault types applied are three phase and single-phase at 132 kV bus bars of MEL itself and other bus bars of the 132 kV substations in the electrical vicinity of Mirpurkhas, Samaro, Mir Wah Gurchani and Sultanabad. The graphic results showing maximum 3-phase and 1-phase fault levels are indicated in Exhibit 4.1. Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bus bars of the network in the electrical vicinity of MEL are placed in Appendix-D. Brief summary of fault currents at significant bus bars of our interest are tabulated in Table 6.2



Table-6.2
Maximum Short Circuit Levels with MEL – Year 2019

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Mirpurkhas Sugar Mills PP 11 kV	38.90	23.36
Mirpurkhas Sugar Mills 132 kV	8.99	9.17
T. A. Yar 132 kV	9.80	9.40
Sultanabad 132 kV	11.93	11.43
Mirpurkhas 132 kV	14.39	15.37
Mirpurkhas-2 132 kV	9.89	10.16
Mir Wah Gurchani 132 kV	6.60	5.96
Mehran 132 kV	6.97	5.12
Samaro 132 kV	6.24	6.47

Comparison of Tables 6.1 and 6.2 show slight increase in short circuit levels for three-phase and single – phase faults due to connection of MEL on the 132 kV bus bars in its vicinity. We find that even after some increase, these fault levels are below the rated short circuit values of the equipment installed on these substations. The maximum short circuit level of MEL 132 kV is 8.99 kA and 9.17 kA for 3-phase and 1-phase faults respectively.

6.4 Fault Current Calculations with MEL – Year 2021

Fault currents have been calculated for the electrical interconnection of proposed scheme in the year 2021. Fault types applied are three phase and single-phase 132 kV bus bars of MEL itself and other bus bars of the 132 kV substations in the electrical vicinity of Mirpurkhas, Samaro, Mir Wah Gurchani and Sultanabad. The graphic results showing maximum 3-phase and 1-phase fault levels are indicated in Exhibit 4.2. Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bus bars of the network in the



electrical vicinity of MEL are placed in Appendix-D. Brief summary of fault currents at significant bus bars of our interest are tabulated in Table 6.3

Table-6.3
Maximum Short Circuit Levels with MEL – Year 2021

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Mirpurkhas Sugar Mills PP 11 kV	39.42	23.60
Mirpurkhas Sugar Mills 132 kV	9.37	9.47
T. A. Yar 132 kV	10.14	9.65
Sultanabad 132 kV	12.61	11.98
Mirpurkhas 132 kV	15.39	16.37
Mirpurkhas-2 132 kV	10.35	10.54
Mir Wah Gurchani 132 kV	6.81	6.10
Mehran 132 kV	7.10	5.21
Samaro 132 kV	6.38	6.58

We find that the short circuit levels have increase a little more, in the future scenario but are still below the rated short circuit values of the equipment installed on these substations. The maximum short circuit level of MEL 132 kV is 9.37 kA and 9.47 kA for 3-phase and 1-phase faults respectively. It would be advisable to go for standard size switchgear of short circuit rating of 40 kA. It would provide large margin for any future increase in short circuit levels due to future generation additions and network reinforcements in this area.

6.5 Conclusion of Short Circuit Analysis

The short circuit analysis results show that for the proposed scheme of interconnection of MEL there is no problem of violations of short circuit ratings of the already installed equipment on the 132 kV equipment of substations in the vicinity of MEL due to fault current contributions from this power house under three-phase faults as well as single phase faults.

The short circuit level of the MEL 132 kV is 8.99 kA and 9.17 kA for 3-phase and 1-phase faults respectively for the year 2019. The same values for the year 2021 are 9.37 kA and 9.47 kA. Therefore industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of MEL taking



care of any future generation additions and system reinforcements in its electrical vicinity and also fulfill the NEPRA Grid Code requirements specified for 132 kV Switchgear.



7. Dynamic Stability Analysis

7.1 Assumptions & Methodology

7.1.1 Dynamic Models

The assumptions about the generator and its parameters are the same as mentioned in Ch.2 of this report.

We have employed the generic dynamic models available in the PSS/E model library for dynamic modeling of the generator, exciter and the governor as follows;

Generator	GENROU
Excitation System	EXST1
Speed Governing System	TGOV1
Inertia Constant	H = 2.837 MW-sec/MVA

7.1.2 System Conditions

The proposed scheme as described in Chapter-4 has been modeled in the dynamic simulation.

All the power plants of WAPDA/NTDCL and IPPs from Tarbela to Hub have been dynamically represented in the simulation model.

7.1.3 Presentation of Results

The plotted results of the simulations runs are placed in Appendix-E. Each simulation is run for its first one second for the steady state conditions of the system prior to fault or disturbance. This is to establish the pre fault/disturbance conditions of the network under study were smooth and steady. Post fault recovery has been monitored for nine seconds. Usually all the transients due to non-linearity die out within 3-4 seconds after disturbance is cleared in the system.

7.1.4 Worst Fault Cases

Three phase faults are considered as the worst disturbance in the system. We have considered 3-phase fault in the closest vicinity of MEL i.e. right at the 132 kV bus bar of MEL substation, cleared in 5 cycles, as normal clearing time for 132 kV i.e.100 ms, followed by a permanent trip of single 132 kV circuit emanating from this substation.



7.2 Dynamic Stability Simulations' Results with MEL in Crushing Season

Three-phase faults were applied on 132 kV bus bars, followed by clearing of fault in 5 cycles (100 ms) or 9 cycles (180 ms) and then tripping of a circuit between the faulted bus and a nearby grid station. Different quantities were monitored for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and the results are plotted in Appendix – E. These fault locations and monitored quantities are discussed one by one as follows;

7.2.1

Fault Location: Three Phase Fault at MEL 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: MEL to Samaro 132 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Mirpurkhas 132 kV 2. MPK-SM PP 11 kV 3. Mirpurkhas-2 132 kV 4. Samaro 132 kV 5. Mirpurkhas 132 kV 6. Mehran 132 kV	The voltages of all the bus bars recover after fault clearance	1.1
Frequency	MPK-SM Mills 132 kV	Recovers after fault clearance	1.2
MW/MVAR Output of the Plant	MPK-SM Mills 11 kV	Recovers after damping down oscillations	1.3
Speed and $P_{\text{mechanical}}$ of the Plant	MPK SM Mills 11 kV	Recovers after damping down oscillations	1.4
Line Flows (MW/MVAR)	MEL to Mirpurkhas-2 132 kV single circuit	Attains steady state value after damping of oscillations	1.5
Rotor Angles	1. MPK-SM PP 11 kV 2. Mehran PP 11 kV 3. Faran PP 11 kV 4. Mir Wah G 11 kV 5. Jamshoro 220 kV 6. Hub 500 kV (reference angle)	Damps down and attain a steady state value	1.6

7.2.2

Fault Location: Three Phase Fault at MEL 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: MEL to Samaro 132 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Mirpurkhas 132 kV 2. MPK-SM PP 11 kV 3. Mirpurkhas-2 132 kV 4. Samaro 132 kV 5. Mirpurkhas 132 kV 6. Mehran 132 kV	The voltages of all the bus bars recover after fault clearance	2.1
Frequency	MPK-SM Mills 132 kV	Recovers after fault clearance	2.2
MW/MVAR Output of the Plant	MPK-SM Mills 11 kV	Recovers after damping down oscillations	2.3
Speed and P_{mechanical} of the Plant	MPK SM Mills 11 kV	Recovers after damping down oscillations	2.4
Line Flows (MW/MVAR)	MEL to Mirpurkhas-2 132 kV single circuit	Attains steady state value after damping of oscillations	2.5
Rotor Angles	1. MPK-SM PP 11 kV 2. Mehran PP 11 kV 3. Faran PP 11 kV 4. Mir Wah G 11 kV 5. Jamshoro 220 kV 6. Hub 500 kV (reference angle)	Damps down and attain a steady state value	2.6

7.2.3

Fault Location: Three Phase Fault at Mirpurkhas-2 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Mirpurkhas-2 to MPK Sugar Mills 132 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. Mirpurkhas 132 kV 2. MPK-SM PP 11 kV 3. Mirpurkhas-2 132 kV 4. Samaro 132 kV 5. Mirpurkhas 132 kV 6. Mehran 132 kV	The voltages of all the bus bars recover after fault clearance	3.1



Frequency	MPK-SM Mills 132 kV	Recovers after fault clearance	3.2
MW/MVAR Output of the Plant	MPK-SM Mills 11 kV	Recovers after damping down oscillations	3.3
Speed and $P_{\text{mechanical}}$ of the Plant	MPK-SM Mills 11 kV	Recovers after damping down oscillations	3.4
Line Flows (MW/MVAR)	MPK-SM to Samaro 132 kV intact single circuit	Attains steady state value after damping of oscillations	3.5
Rotor Angles	1. MPK-SM PP 11 kV 2. Mehran PP 11 kV 3. Faran PP 11 kV 4. Mir Wah G 11 kV 5. Jamshoro 220 kV 6. Hub 500 kV (reference angle)	Damps down and attain a steady state value	3.6

7.3 Conclusion of Dynamic Stability Analysis

The results of dynamic stability show that the system is very strong and stable for the proposed scheme for the severest possible faults of 132 kV systems near to and far of MEL. Therefore there is no problem of dynamic stability for interconnection of MEL; it fulfills all the criteria of dynamic stability.



8. Conclusions

- ❖ Grid Interconnection Study for 26 MW (Gross Capacity) Mirpurkhas Energy Limited is carried out which is located in District Mirpurkhas, Sindh. The nearest HESCO grid facility available for interconnection to MEL is Mirpurkhas-2 132 kV Grid Station and Samaro 132 kV Grid Station.
 - ❖ Keeping in view the location of Power Project, it is proposed to connect Mirpurkhas Energy Limited via looping In-Out of the existing Transmission Line from 132 kV Samaro grid station to Mirpurkhas-2 132 kV grid station. The looping distance as confirmed from site visit would be 2 km and the conductor used would be Lynx. The scheme is shown in Sketch-2 in Appendix-B.
 - ❖ MEL would generate power at 11 kV voltage level from where it is stepped-up to 132 kV using two 132/11 kV transformers with rating of 31.5/40 MVA.
 - ❖ The proposed scheme would require two 132 kV line bays at the 132 kV substation of MEL for the connection to 132 kV Samaro grid station and Mirpurkhas-2 132 kV grid station. Furthermore it would also require two transformer bays for the connection of two 132/11 kV transformers with rating of 31.5/40 MVA.
 - ❖ With the gross capacity of 26 MW, the spillover from MEL would be 23.50 MW in Off-Season and 20.50 MW in the Crushing Season.
 - ❖ In view of planned COD of MEL in September 2018, the above proposed interconnection scheme has been tested for steady state conditions through detailed load flow studies for the peak conditions of
 - January 2019 for maximum thermal power dispatches in the grid during the Crushing Season for MEL.
 - September 2019 for maximum hydropower dispatches in the grid during the off-season for MEL.
- The system conditions of normal and N-1 contingency have been studied to meet the reliability criteria of NEPRA Grid Code.
- ❖ The proposed scheme of interconnection has also been tested for the extended term scenario of peak load conditions of the year 2021 for steady state conditions.

- ❖ Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the spillover of up to 23.50 MW power of the Plant under normal as well as contingency conditions.
- ❖ The short circuit analysis has been carried out to calculate maximum fault levels at MEL and the substations of 132 kV in its vicinity. We find that the fault currents for the proposed scheme are within the rated short circuit capacities of switchgear installed at these substations. There are no violations of exceeding the rating of the equipment due to contribution of fault current from MEL.
- ❖ The maximum short circuit levels of MEL 132 kV is 8.99 kA and 9.17 kA for 3-phase and 1-phase faults respectively for the Year 2019 and 9.37 kA and 9.47 kA for 3-phase and 1-phase faults respectively for the Year 2021. It would be advisable to go for standard size switchgear of short circuit rating of 40 kA. It would provide large margin for any future increase in short circuit levels due to future generation additions and network reinforcements in this area.
- ❖ The dynamic stability analysis of proposed scheme of interconnection has been carried out for January 2019. The stability check for the worst case of three phase fault right on the 132 kV bus bar of MEL substation followed by the final trip of one 132 kV circuit emanating from this substation, has been performed for fault clearing of 5 (100 ms) and 9 cycles (180 ms), in case of stuck breaker, as understood to be the normal fault clearing time of 132 kV protection system. The stability of system for far end faults of 3-phase occurring at 132 kV bus bar have also been checked. The proposed scheme successfully passed the dynamic stability checks for near and far faults for the most stringent cases. The system is found strong enough to stay stable and recovered with fast damping.
- ❖ The proposed scheme of interconnection has no technical constraints or problems, it fulfills all the criteria of reliability and stability under steady state load flow, contingency load flows, short circuit currents and dynamic/transient conditions; and is therefore recommended to be adopted.

Appendices

Appendix - A

1- Generation Transmission Plan

2- Load Forecast & PMS Sheet

For Chapter 4

List of Underconstruction/Planned Generation Projects								
Sr. #	Fiscal Year	Name of Project	Agency	Fuel	Location	Installed Capacity	Commissioning Date	Total Installed Capacity
		Existing capacity				(MW)		(MW)
								22409.0
1	2016-17	M/s Hamza Sugar Mills Ltd.	AEDB	Baggase	Khanpur, Punjab	15	Nov. 2016	
2		CHASNUPP-III	PAEC	Nucl	Chashma, Punjab	340	Nov. 2016	
3		Zonergy-IV & V	PPDB	Solar	Lal Sohna (Cholistan), Punjab	200	Nov. 2016	
4		M/s HydroChina Dawood Power Ltd.	AEDB	Wind	Gharo, Sindh	49.5	Nov. 2016	
5		M/s United Energy Pakistan Limited	AEDB	Wind	Jhimpir, Sindh	99	Nov. 2016	
6		M/s Layyah Sugar Mills Ltd.	AEDB	Baggase	Layyah, Punjab	41	Dec. 2016	
7		CHASNUPP-IV	PAEC	Nucl	Chashma, Punjab	340	Dec. 2016	
8		Zonergy-VI	PPDB	Solar	Lal Sohna (Cholistan), Punjab	100	Dec. 2016	
9		Zonergy-VII	PPDB	Solar	Lal Sohna (Cholistan), Punjab	100	Jan. 2017	
10		Zonergy-VIII & IX	PPDB	Solar	Lal Sohna (Cholistan), Punjab	200	Feb. 2017	
11		M/s Ethrad Power Generation Ltd.	AEDB	Baggase	Rahim Yar Khan, Punjab	67	Feb. 2017	
12		M/s Alliance Sugar Mills Ltd.	AEDB	Baggase	Ghotki, Sindh	19	Feb. 2017	
13		LNG Based Plants (2*GT)	PPDB	Imp. LNG	Bhikki, Punjab	800	Mar. 2017	
14		Patridi HPP	PPDB	Hydel	Kunhar River, KPK/AJK	147	Apr. 2017	
15		LNG Based Plants (2*GT)	PPDB	Imp. LNG	Haveli Bahadur Shah (Jhang), Punjab	800	Apr. 2017	
16		Gas Based Power Plants	PPDB	Imp. LNG	Existing Plant Sites	1000	Apr. 2017	
17		LNG Based Plants (2*GT)	PPDB	Imp. LNG	Balokki, Punjab	800	May. 2017	
18		M/s Chamar Sugar Mills Ltd.	AEDB	Baggase	Tandlianwala, Punjab	22	Jun. 2017	
19		M/s Sachal Energy Development (Pvt.) Limited	AEDB	Wind	Jhimpir, Sindh	49.5	Jun. 2017	
20		Tarbela 4th Ext. Project	WAPDA	Hydel	Tarbela, KPK	1410	Jun. 2017	
		Total Generation Addition in 2016-17				6599		29008
21	2017-18	Neehun Jhelum Hydel	WAPDA	Hydel	Nauseri/Muzaffarabad, AJK	969	Aug. 2017	
22		M/s Almoz Industries Ltd.	AEDB	Baggase	Mianwali, Punjab	36	Dec. 2017	
23		M/s Safina Sugar Mills	AEDB	Baggase	Lalian, Sangodha	20	Dec. 2017	
24		M/s Shalraj Sugar Mills Ltd.	AEDB	Baggase	Mandi Bahaudin, Punjab	32	Dec. 2017	
25		M/s RYK Energy Ltd.	AEDB	Baggase	Rahim Yar Khan, Punjab	32	Dec. 2017	
26		M/s SSJD Bioenergy	AEDB	Baggase	Mirpurkhas, Sindh	12	Dec. 2017	
27		M/s Lumen Energia Pvt Ltd	AEDB	Baggase	Jhang, Punjab	12	Dec. 2017	
28		Shandong Imported Coal Based Power Project	PPDB	Imp. Coal	Sahiwal, Punjab	1320	Dec. 2017	
29		LNG Based Plants (1*ST)	PPDB	Imp. LNG	Bhikki, Punjab	400	Dec. 2017	
30		LNG Based Plants (1*ST)	PPDB	Imp. LNG	Balokki, Punjab	400	Dec. 2017	
31		LNG Based Plants (1*ST)	PPDB	Imp. LNG	Haveli Bahadur Shah (Jhang), Punjab	400	Dec. 2017	
32		M/s Jhimpir Wind Power (Pvt.) Limited	AEDB	Wind	Jhimpir, Sindh	50	Feb. 2018	
33		M/s Hava Energy (Pvt.) Limited	AEDB	Wind	Jhimpir, Sindh	50	Mar. 2018	
34		M/s Hartford Alternative Energy (Pvt.) Limited	AEDB	Wind	Jhimpir, Sindh	50	Apr. 2018	

List of Underconstruction/Planned Generation Projects								
Sr. #	Fiscal Year	Name of Project	Agency	Fuel	Location	Installed Capacity	Commissioning Date	Total Installed Capacity
35		M/s Tricon Boston Consulting Corporation (Pvt.) Limited (A)	AEDB	Wind	Jhimpir, Sindh	50	Apr. 2018	
36		M/s Tricon Boston Consulting Corporation (Pvt.) Limited (B)	AEDB	Wind	Jhimpir, Sindh	50	May. 2018	
37		M/s Tricon Boston Consulting Corporation (Pvt.) Limited (C)	AEDB	Wind	Jhimpir, Sindh	50	Jun. 2018	
38		M/s Three Gorges Second Wind Farm Pakistan Ltd (Wind Eagle Limited)	AEDB	Wind	Jhimpir, Sindh	49.5	Jun. 2018	
39		M/s Three Gorges Third Wind Farm Pakistan Ltd (Wind Eagle Limited)	AEDB	Wind	Jhimpir, Sindh	49.5	Jun. 2018	
40		Port Qasim Power Project	PPIB	Imp. Coal	Port Qasim Karachi, Sindh	1320	Jun. 2018	
		Total Generation Addition in 2017-18				5352		34360
41	2018-19	Golen Gol HPP	WAPDA	Hydel	Chikral, KPK	106	Jul. 2018	
42		M/s Zephyr Power Pvt. Ltd.	AEDB	Wind	Gharo, Sindh	50	Nov. 2018	
43		Grange Holding	PPIB	Imp. Coal	Arifwala, Punjab	163	Jan. 2019	
44		Shanghai Electric Power Project	PPIB	Dom. Coal	Thar, Sindh	1320	Mar. 2019	
45		HUB Power Company Ltd. (Unit-I)	PPIB	Imp. Coal	HUB, Baluchistan	660	Mar. 2019	
46		Western Energy	AEDB	Wind	Jhimpir, Sindh	50	Mar. 2019	
47		HUB Power Company Ltd. (Unit-II)	PPIB	Imp. Coal	HUB, Baluchistan	660	Jun. 2019	
48		Engro Powergen Project	PPIB	Dom. Coal	Thar, Sindh	660	Jun. 2019	
		Total Generation Addition in 2018-19				3669		38029
49		Coal Plant at Muzaffargarh	PPDB	Imp. Coal	Muzaffargarh, Punjab	600	Sep. 2019	
50		Gulpur Poonch river	PPIB	Hydel	Poonch River/Gulpur, AJK	102	Oct. 2019	
51		CASA	GoP	Import	Cross Border Interconnection	1000	Dec. 2019	
52		TPS Jamshoro (Phase-I)	GENCOs	Imp. Coal	Jamshoro, Sindh	660	Dec. 2019	
53		Trans Atlantic Energy	AEDB	Wind	Jhimpir, Sindh	50	Dec. 2019	
54		Norinco	AEDB	Wind	Jhimpir, Sindh	50	Dec. 2019	
55		ACT 2	AEDB	Wind	Jhimpir, Sindh	50	Dec. 2019	
56		Artistic Milliners	AEDB	Wind	Jhimpir, Sindh	50	Dec. 2019	
57		Harvey Wind Power Project	AEDB	Wind	Jhimpir, Sindh	50	Dec. 2019	
58		Zulka Energy	AEDB	Wind	Jhimpir, Sindh	50	Dec. 2019	
59		Gul Ahmed	AEDB	Wind	Jhimpir, Sindh	50	Dec. 2019	
60		Din Group	AEDB	Wind	Jhimpir, Sindh	50	Dec. 2019	
61		Shahen Foundation	AEDB	Wind	Jhimpir, Sindh	50	Dec. 2019	
62		HUB Power Project, Thar Block-II	PPIB	Dom. Coal	Thar, Sindh	330	Jan. 2020	
63		Thal NOVA Power Project, Thar Block-II	PPIB	Dom. Coal	Thar, Sindh	330	Jan. 2020	
64		Keyal Khwar	WAPDA	Hydel	Dasu District, KPK	128	Jan. 2020	
		Total Generation Addition in 2019-20				3600		41629
65		TPS Jamshoro (Phase-II)	GENCOs	Imp. Coal	Jamshoro, Sindh	660	Jul. 2020	
66		Siddiqsons Limited	PPIB	Imp. Coal	Port Qasim, Sindh	350	Oct. 2020	
67		Karachi Coastal Power Plant (Unit-I)	PAEC	Nucl	Karachi	1100	Nov. 2020	
68		Lucky Electric Power Company Ltd.	PPIB	Imp. Coal	Port Qasim, Sindh	660	Dec. 2020	

List of Underconstruction/Planned Generation Projects

List of Under Construction/Planned Generation Projects								
Sr. #	Fiscal Year	Name of Project	Agency	Fuel	Location	Installed Capacity	Commissioning Date	Total Installed Capacity
69		Dasu HPP (Phase-1)	WAPDA	Hydel	7km upstream of Dasu Village on Indus River, KPK	2160	Feb. 2021	
70		Oracle Coal Power Project	PFIB	Dom. Coal	Thar, Sindh	1320	Mar. 2021	
71		Tarbela 5th Ext. Project	WAPDA	Hydel	Tarbela, KPK	1410	Jun. 2021	
		Total Generation Addition in 2020-21					7660	
72	2021-22	Korot HPP	PFIB	Hydel	Jhelum River, Distt. Rawalpindi, Punjab	720	Aug. 2021	
73		Karachi Coastal Power Plant (Unit-II)	PABC	Nucl	Karachi	1100	Oct. 2021	
74		Suki Kinarri HPP	PFIB	Hydel	Kunhar River/Manshehra, KPK	870	Jun. 2022	
75		Kotli	AJKPDO	Hydel.	Poonchi River/Kotli, AJK	100	Jun. 2022	
76		Coal Plant at Lakhra	GBNCOs	Dom. Coal	Lakhra, Sindh	660	Jun. 2022	
		Total Generation Addition in 2021-22					3450	
Total Generation Addition upto 2021-22						30330		
References: As per data provided by WAPDA Hydel, GENCOs, AJPDO, PGO, PFIB, AEDB, PPA, TCE and PAF.								

As per data provided by WAFDA Hyderabad, GENCO, AIKROD, PEDD, EPIS, ADRB, PRAN, ICEK and PARS

NTDC TRANSMISSION EXPANSION PLAN

500 kV TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	500 kV Transmission Line/ 500/220 kV Transformer Description	No. of S/C Lines	Length of each Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
Ongoing Projects						
1		Augmentation of 1x450 MVA T/F with 1x750 MVA capacity at Rewat 500 kV G/S			1 x 750	2016-17
2	Lahore New (South)	Sahiwal -- Lahore single circuit In/Out at Lahore New	2	15	2 x 750	2016-17
3		Gujranwala -- Lahore single circuit In/Out at Lahore New	2	50		2016-17

NTDC TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	500 kV Transmission Line/ 500/220 kV Transformer Description	No. of S/C Lines	Length of each Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
Ready For Implementation Projects						
4		Jamshoro – Moro	1	200		2016-17
5		Dadu – Moro	1	55		2016-17
6		Moro – R.Y. Khan	1	335		2016-17
7		Ext. at Jamshoro, 3rd 500/220 kV T/F			1 x 450	2016-17
8	R.Y. Khan	Guddu – Multan 3rd Circuit In/Out at R.Y. Khan	1	30	2 x 600	2017-18
9		Guddu New Power Plant – M. Garh	1	256		2017-18
10		Neelum Jhelum HPP - Gakkhar (Gujranwala)	2	270		2017-18
11		Lahore South – Sahiwal S/C In/Out at Sahiwal Coal Power Plant	2	0.5		2017-18
12		Ext. at Sahiwal, 3rd 500/220 kV T/F			1 x 600	2017-18
Future Development Projects						
13		Lahore Old – Gatti S/C In/Out at 1200 MW Bhikki	2	5		2016-17
14		Lahore South – 1200 MW Balloki	2	40		2016-17
15		Ext. at Lahore South, 3rd 500/220 kV T/F			1 x 750	2016-17
16		Gatti – M.Garh S/C In/Out at 1200 MW Haveli Bahadur Shah	2	5		2016-17
17		Gatti – Multan S/C In/Out at 1200 MW Haveli Bahadur Shah	2	15		2016-17

NTDC TRANSMISSION EXPANSION PLAN

Sr. No.	31New Substation	500 kV Transmission Line/ 500/220 kV Transformer Description	No. of S/C Lines	Length of each Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
18		Augmentation of 3x237 MVA T/Fs with 3x450 MVA capacity at Tarbela 500 kV G/S			3x 450	2016-17
19	Matlari Switching Station	Port Qasim Coal Power Plant – Matlari	2	180		2017-18
20		In/out of existing 500 kV Jamshoro – Dadu S/C at Matlari Switching/ Converter Station	2	30		2017-18
21	HVDC Converter Station at Matlari	± 660 kV HVDC Bi-pole from Matlari Converter Station - Lahore South Converter station		878		2018-19
22		Engro Thar CFPP – Matlari	2	250		2018-19
23		Hubco Coal Power Plant– Matlari Switching/ Converter Station	2	220		2018-19
24	Faisalabad West	M. Garh – Gatti circuit In/Out at Faisalabad West	2	2	2 x 750	2018-19
25		Multan – Gatti circuit In/Out at Faisalabad West	2	30		2018-19
26	Extension of 500/220 kV Transformers	Addition of 1x450 MVA T/F at 550/220 kV Sheikh Muhammadi			1x450	2018-19
27		Addition of 1x600 MVA T/F at 550/220 kV Nokhar			1x600	2018-19
28	Lahore HVDC Converter Station (CS)	In/Out of Lahore New (South) – Lahore D/C at Lahore HVDC CS	4	4+25		2018-19
29	Lahore North	Lahore North – Lahore South	2	60	2 x 750	2018-19
30		Lahore North – Gujranwala (Gakkhar)	2	50		2018-19

NTDC TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	500 kV Transmission Line/ 500/220 kV Transformer Description	No. of S/C Lines	Length of each Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
31	Islamabad West	Ghazi Brotha – Rewat S/C In/Out at Islamabad West	2	7.4	2x750	2018-19
32		Tarbela-Rewat In/Out S/C at Islamabad West	2	10.1		2018-19
33		In/out of 500 kV Muzaffar Garh – HB Shah S/C at Muzaffa Garh CFPP	2	15		2019-20
35	500/220/132 kV Chakwal New	In/Out of the existing Ghazi Barotha – Gatti at Chakwal New	2	3	2x450	2018-19
36		In/Out of the existing Chakkar – Rewat at Chakwal New	2	30		2018-19
37	± 500kV HVDC Converter Station at Peshawar New	± 500 kV HVDC Bipole to Peshawar New (CASA-1000)				2019-20
38	Peshawar New	In/out of existing 500 kV Tarbela – Peshawar S/C at Peshawar New	2	15	2 x 750	2019-20
39	Ludewala	Ludewala – Faisalabad West	2	100	2 x 600	2019-20
40		Ludewala – Peshawar New	2	325		2019-20
41		Engro Thar CFPP– Matiari S/C In/Out at Shanghai Electric CFPP with 40% series compensation on both 500 kV circuits (Engro CFPP – Matiari S/C & Shanghai Electric CFPP - Matiari S/C).	2	15		2019-20
42		Tarbela 5 th Ext. switchyard - Islamabad West	2	52.4		2020-21

NTDC TRANSMISSION EXPANSION PLAN

S. No.	New Substation	500 kV Transmission Line/ 500/220 kV Transformer Description	No. of S/C Lines	Length of each Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
3	Port Qasim Switching/ Converter Station	± 660 kV HVDC Bi-pole from 500kV Port Qasim Switching /Converter station – FSD WEST		1050		2020-21
4		Siddiqsons CFPP – 500kV Port Qasim Switching/ Converter Station	2	35		2020-21
5		Siddiqsons CFPP – 500kV Port Qasim Switching/ Converter Station S/C In/Out at Lucky	2	3		2020-21
6		Port Qasim Coal Power Plant – Matiari switching/ converter station S/C In/Out at K-2/K-3	2	70		2020-21
7		Hubco Coal Power Plant - Matiari switching/ converter station S/C In/Out at K-2/K-3	2	5		2021-22
8	Switching Station at Mansehra	Dasu HPP to Mansehra	2	140		2020-21
9		Mansehra to Islamabad West	2	100		2020-21
10		Mansehra to Faisalabad West with 40% series compensation	2	375		2020-21
11	Switching Station at Alliot	Neelum Jhelum HPP – Gujranwala D/C In/Out at Alliot.	4	2		2021-22
12		Alliot – Gujranwala Circuit#2 In/Out at Karot	2	5		2021-22
13		Suki Kinari HPP – Alliot	2	100		2021-22
14		Alliot – Islamabad West	2	96		2021-22
15	Vehari	Multan – Sahiwal S/C In/Out at Vehari	2	15	2x750	2021-22

NTDC TRANSMISSION EXPANSION PLAN

220 kV TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	220 kV Transmission Line/ 220/132 kV Transformer Description	No. of D/C Lines	Length of D/C Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
Ongoing Projects						
1		Augmentation of 2x160 MVA T/F with 2x250 MVA capacity at Sheikh Muhammadi 500 kV G/S			3 x 250	2016-17
2		Augmentation of 2x160 MVA T/F with 2x250 MVA capacity at Burhan 220 kV G/S			3 x 250	2016-17
3		Augmentation of 2x160 MVA T/F with 2x250 MVA capacity at Quetta Industrial 220 kV G/S			2 x 250	2016-17
4	450 MVAR SVC at New Kot Lakhpat 220kV G/S					2016-17
5	Ghazi Road	N. Kotlakhpat – Sarfraznagar S/C In/Out at Ghazi Road	1	45	3 x 160	2016-17
6	Gujrat New	Mangla – Gujranwala S/C & Mangla – Gakkhar S/C In/Out at Gujrat	2	4	3 x 250	2016-17
7	Christian New	Vehari – Christian New	1	65	2 x 250	2016-17

NTDC TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	220 kV Transmission Line/ 220/132 kV Transformer Description	No. of D/C Lines	Length of D/C Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
8		Uch II – Sibbi	1	125		2016-17
9	Lahore New (South) 500/220 kV	Kot Lakhpat New – Wapda Town S/C In/Out at Lahore New	1	45		2016-17
10		Kot Lakhpat New – Ghazi Road S/C In/Out at Lahore New	1	50		2016-17
11	Lal Suhanra	Lal Suhanra – Bahawalpur	1	40	3 x 250	2016-17
12	Mansehra	Allai Khwar – ISPR double circuit In/Out at Mansehra	2	1	2 x 250	2016-17
13	D.M. Jamali	Uch – Guddu S/C In/Out at D.M. Jamali	1	5	1 x 160 + 1 x 100	2016-17
14	Nowshera Ind.	G.Brotha – Shahibagh D/C In/Out at Nowshera Ind.	2	5	3 x 250	2016-17
15	D.I. Khan	In & Out of C1/C-2 – C/3 S/C at D.I. Khan	1	100	2 x 250	2016-17
16	Lalian New	Gatti – Ludewala D/C In/Out at Lalian New.	2	4	3 x 250	2016-17

NTDC TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	220 kV Transmission Line/ 220/132 kV Transformer Description	No. of D/C Lines	Length of D/C Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
17	2nd Source of supply to 220 kV GIS Islamabad University	In & Out of Manshera – ISPR S/C at Islamabad University	1	40		2017-18
18	Chakdara New	Mardan – Shahi Bagh New S/C In/Out at Chakdara New	1	85	2 x 250	2016-17
19		Augmentation of 1 x 160 MVA T/Fs with 1x250 MVA capacity and Extension of 1x250MVA at Rewat 500 kV G/S			1 x 250 + 1 x 250	2016-17
20	Jhimpir-1	Jhimpir-1 – T.M. Khan Road	1	70	3 x 250	2017-18
21		Reconductoring of 220 kV Tarbela – ISPR D/C on twin bundled Rail conductor	1	62.5		2017-18
22		Replacement of existing 220 kV Tarbela – Burhan D/C with twin bundled Rail conductor D/C T/L	1	35.1		2017-18
23	Gharo	Jhimpir – Gharo	1	75	2 x 250	2017-18
24	Chakwal New 500/220/132 kV				3x250	2018-19

NTDC TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	220 kV Transmission Line/ 220/132 kV Transformer Description	No. of D/C Lines	Length of D/C Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
25	Faisalabad West 500/220/132 kV	Faisalabad West – T.T. Singh	1	45	3 x 250	2018-19
26		Faisalabad West – Lalian New	1	80		2018-19
27	Islamabad West 500/220/132 kV	In/Out of Burhan – ISPR S/C at Islamabad West	12	15		2018-19
28		In/Out of Mansehra/ Islamabad University – ISPR D/C at Islamabad West	2	25		2018-19
29	Zhob	DIK-Zhob	1	220	2x160	2018-19
30	Mirpurkhas New	In & Out of the Hala Road- T.M. Kah S/C at Mirpurkhas New	1	70	2 x 250	2018-19
31	2nd Source of supply to 220 kV Hala Road	In & Out of Jamshoro – T.M.Khan S/C at Hala Road	1	10		2018-19
32	Mastung	Sibbi – Mastung	1	120	2 x 250	2018-19
33	220kV Kohat	Peshawar New – Kohat	1	50	2 x 250	2019-20
34	220kV Kamra	In/Out of Islamabad West-ISPR S/C at Kamra	1	5	2 x 250	2020-21
35	Lahore North	In/Out of Ghazi Road/Ravi – K.S.K D/C at Lahore North	2	5		2019-20
36		In/Out of Lahore Old – Ravi S/C at Lahore North	1	10		2019-20

NTDC TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	220 kV Transmission Line/ 220/132 kV Transformer Description	No. of D/C Lines	Length of D/C Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
37	Peshawar New	In/out of Peshawar – Shahibagh D/C at Peshawar New	2	12		2019-20
38	220kV Jamrud	Peshawar – Jamrud	1	10	2 x 250	2020-21
39	220 kV Shadman	Shadman – Bund Road	1	15	2 x 250	2019-20
40	220 kV Arifwala	In & out of Yousafwala- Kassowal D/C at Arifwala	4	5	2x250	2019-20
41	220 kV Jauharabad	In/Out of C-1/C-2/C-3/C-4 – Ludewala D/C at Jauharabad	2	5	2 x 250	2020-21
42	220 kV Jhimpir-2	In/Out of one circuit of the existing Jamshoro – KDA-33 D/C transmission line at Jhimpir-2	1	18	3x250	2019-20
		In/Out of one of the planned Jhimpir New (Jhimpir-1) – Ghara New D/C transmission line at Jhimpir-2	1	7		2019-20

NTDC TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	220 kV Transmission Line/ 220/132 kV Transformer Description	Transformer Capacity (MVA)	Expected Year of Commissioning
43	Extension & Augmentation of 220 kV Transformers	Addition of 1x160 MVA T/F at 220 kV Daud Khel	1x160	2019-20
44		Augmentation 3 T/Fs with 3x250 MVA T/Fs at 220 kV Banuu	3x250	
45				
46		Addition of 1x250 MVA T/F at 220 kV ISB University	1x250	
47		Augmentation of all T/Fs with 3x250 MVA at 220/132 kV Nokhar	3x250	
48		Addition of 1x250 MVA T/F at 220 kV NKLP	1x250	
49		Augmentation of all T/Fs with 3x250 MVA at 220/132 kV Wapda Town	3x250	
50		Augmentation of all T/Fs with 3x250 MVA T/Fs at 220/132 kV Ludewala	3x250	
51		Augmentation of 1x160 MVA T/F to 1x250 MVA T/F at 220 kV Bahawalpur	1x250	
52		Replacement of 4x63.5 MVA T/Fs with 2x250 MVA T/Fs 220 kV NGPS	2x250	
53		Addition of 1x250 MVA T/F at 220 kV Rohri	1x250	
54		Replacement & Augmentation of 1x285 MVA & 1x160 MVA T/F s with 2x250 MVA T/Fs at 220 kV Guddu	2x250	

NTDC TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	220 kV Transmission Line/ 220/132 kV Transformer Description	Transformer Capacity (MVA)	Expected Year of Commissioning
55	Extension & Augmentation of 220 kV Transformers	Addition of 1x160 MVA T/F at 220/132 kV Khuzdar	1 x160	2019-20
56		Addition of 1x250 MVA T/F at 220/132 kV Loralai	1x250	
57		Augmentation of 3x160 MVA T/F with 1x250 MVA T/F at 220 kV Quetta Industrial	1x250	
58		Augmentation three T/Fs (220/132 kV) with 3x250 MVA T/Fs & Addition of 1x250 MVA T/F at 220/132 kV Sheikhpura	4x250	

NTDC TRANSMISSION EXPANSION PLAN

Sr. No.	New Substation	220 kV Transmission Line/ 220/132 kV Transformer Description	No. of D/C Lines	Length of D/C Line (km)	Transformer Capacity (MVA)	Expected Year of Commissioning
59	220 kV H.Faqirian	H.Faqirian – Ludewala	1	58	2x250	2020-21
60	220 kV M3-Industrial	In & out of Faisalabad West-Lalian New S/C at Multan Industrial	2	12.5	2x250	2021-22
61	220 kV Alizai	Alizai-Kohat	2	110	2x250	2021-22

DISCO-wise Peak Demand Forecast (MW)

Name	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	Growth (%)
LESCO	4588	5020	5407	5811	6167	6479	6739	6984	7249	7517	7788	5.4
GEPCO	2190	2353	2519	2696	2859	3013	3173	3340	3513	3689	3876	5.9
FESCO	2962	3118	3297	3487	3704	3930	4167	4465	4786	5165	5549	6.5
IESCO	2347	2494	2650	2856	3025	3202	3377	3562	3752	3944	4138	5.8
MEPCO	3570	3805	4044	4287	4535	4786	5042	5303	5568	5838	6113	5.5
PESCO	2958	3104	3255	3412	3574	3741	3915	4096	4282	4476	4677	4.7
HESCO	1251	1301	1354	1408	1465	1524	1585	1649	1716	1786	1858	4.0
QESCO	1709	1768	1829	1893	1961	2030	2102	2177	2255	2337	2422	3.5
TESCO	653	674	696	719	752	777	803	830	858	887	918	3.5
SEPCO	1074	1141	1210	1282	1358	1436	1517	1602	1691	1783	1879	5.8
DISCOs Demand (undiversified)	23302	24778	26261	27851	29399	30919	32422	34009	35671	37422	39217	5.3
Coincidence Factor (%)	80.85%	80.85%	80.85%	80.85%	80.85%	80.85%	80.85%	80.85%	80.85%	80.85%	80.85%	
DISCOs Demand (Diversified)	18840	20094	21233	22518	23770	24998	26214	27497	28840	30256	31708	5.3
T & T Losses (500 & 220kV)	498	530	561	595	628	661	693	727	763	800	838	
% T & T Losses (500 & 220kV)	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	
NTDC Demand	19338	20563	21794	23114	24398	25659	26907	28224	29603	31056	32546	5.3
Auxiliary Consumption	588	625	662	703	742	780	818	858	900	944	989	
% Auxiliary Consumption	2.95	2.95	2.95	2.95	2.95	2.95	2.95	2.95	2.95	2.95	2.95	
NTDC Demand w/o Export to K-Electric	19926	21189	22457	23816	25140	26439	27725	29082	30503	32000	33535	5.3
Growth Rate (%)		6.34%	5.98%	6.05%	5.56%	5.17%	4.86%	4.89%	4.89%	4.91%	4.80%	
Export to KESC	650	650	650	650	650	650	650	650	650	650	650	
NTDC Demand With Export to K-Electric	20576	21839	23107	24466	25790	27089	28375	29732	31153	32650	34185	5.2
Growth Rate (%)		6.14	5.8	5.9	5.4	5.0	4.7	4.8	4.8	4.8	4.7	

N.B. The Demand of Distribution Companies also includes their respective losses.

DATA PROVIDED BY CLIENT

1. Generator

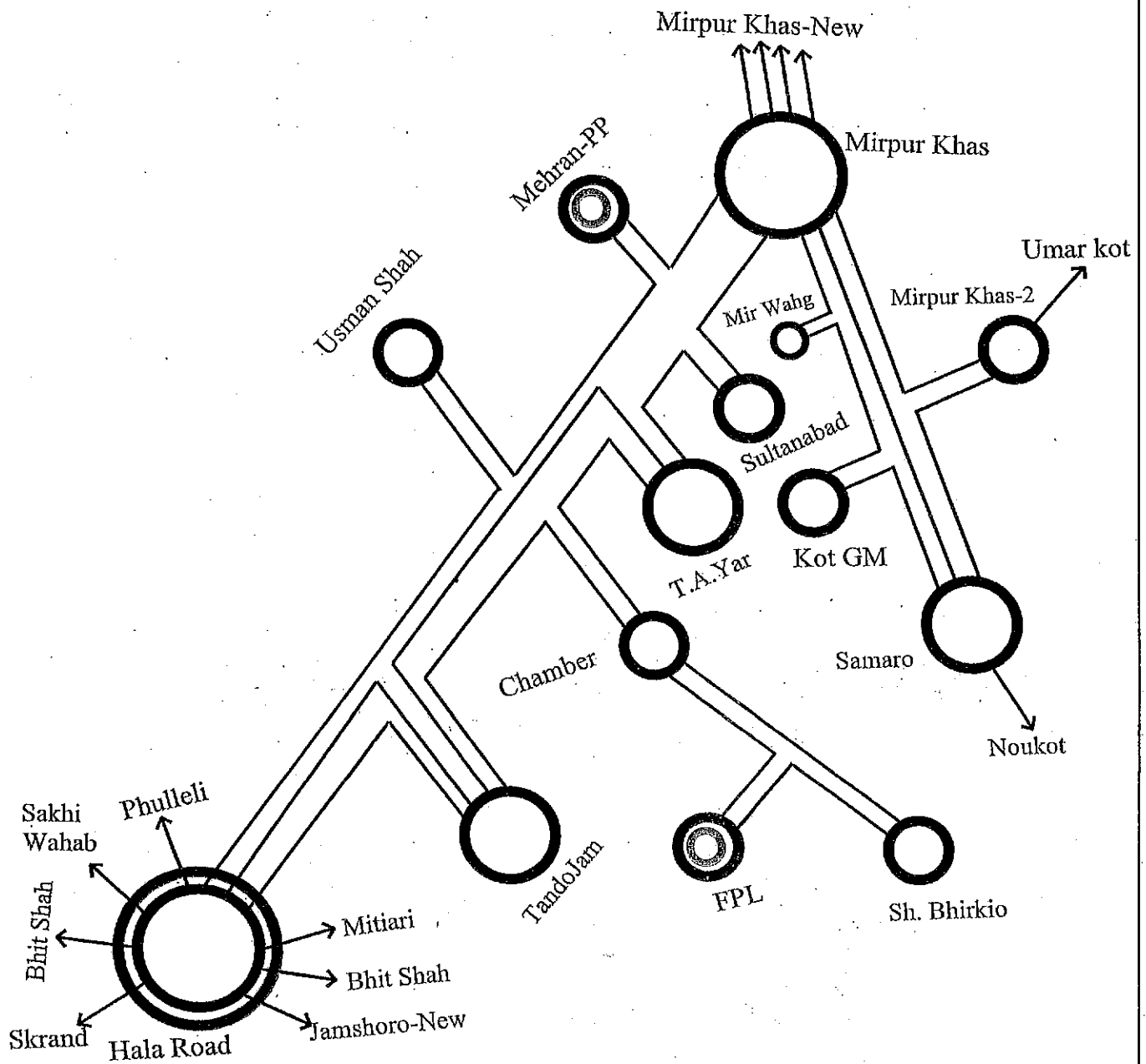
Type	1DU2060-8AE02-Z
Manufacturer	SIEMENS
Nameplate Rating (kVA) of each machine	33 650
Rated voltage at generator terminal (kV) for each machine	11000
Number of Phases/poles	3 / 4
Frequency Hz	50
Rated Speed (rpm)	1500
Power factor range (leading/lagging)	0,8 / 0,95
Short circuit ratio (SCR)	0,53
Insulation class	F
Type of cooling	CACW
Stator winding temperature rise	B
Rotor winding temperature rise	B
Generator efficiency at full load at 0.85 pf	98,35%
Direct-axis synchronous reactance (X_d (sat))	188,9%
Direct-axis reactances X_d (un-sat)	206,0%
Quadrature-axis reactances X_q (sat)	172,0%
Quadrature-axis reactances X_q (un-sat)	187,3%
Direct-axis transient reactance ($x'd$ (sat))	26,1%
Direct-axis transient reactance $x'd$ (un-sat)	33,8%
Quadrature-axis transient reactance $x'q$ (sat)	172,0%
Quadrature-axis transient reactance $x'q$ (un-sat)	187,3%
Direct-axis sub-transient reactance ($x''d$ (sat))	18,0%
Direct-axis sub-transient reactance $x''d$ (un-sat)	24,1%
Quadrature-axis sub-transient reactance ($x''q$ (sat))	19,1%

Quadrature-axis sub-transient reactance x''_q (un-sat)	26,3%
Negative sequence (X_2 (sat))	18,5%
Zero sequence (X_0 (sat))	15,4%
Leakage reactance (X_{leak} (sat))	14,8%
Leakage reactance (X_{leak} (un sat))	19,3%
GENERATOR TIME CONSTANT	
Direct-axis open-circuit transient time constant T'_{do}	5,516s
Direct-axis short circuit transient time constant T'_d	0,542s
Direct-axis open circuit sub-transient time constant (T''_{do})	0,075s
Direct-axis short circuit subtransient time constant (T''_d)	0,053s
DC-decay time constant (T_a)	0,228s
Quadrature axis short circuit subtransient time constant T''_q	0,084s
Quadrature axis open circuit subtransient time constant T''_{qo}	0,602s
Quadrature-axis open-circuit transient time constant T'_{qo}	0,000s
Inertia Constant of Generator and Turbine (H)	$H_c=2,837s$, $I_s=7725kgm^{-2}$
Generator Losses and Efficiencies:	
Efficiency: At full load	479kW / 98,25%

Appendix -B

Map & Sketches

Network Around Proposed Site of Mirpurkhas Energy Ltd. PP **(without MEL PP, Year 2019)**



Legend

11 kV. _____
 132 kV _____
 220 kV _____

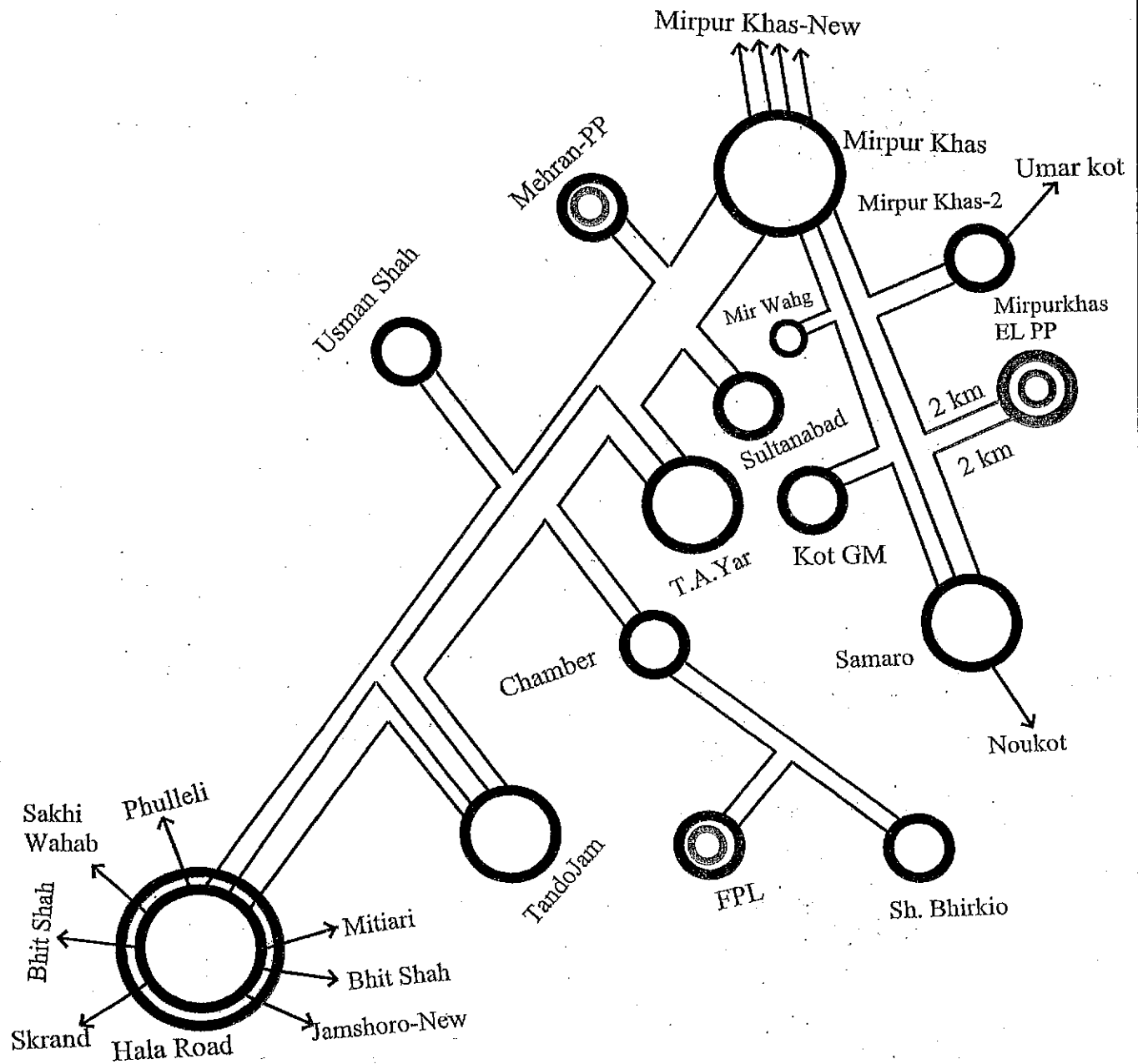
Sketch-1

Interconnection Study of
 Mirpurkhas Energy Limited PP

Power Planners International

DATE 2016	SHEET 1	DWG NO. MEL Sketch-1.DWG	REV
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Network Around Proposed Site of Mirpurkhas Energy Ltd. PP **(with MEL PP, Year 2019)**



Legend

Proposed 11 kV	_____
Proposed 132 kV	=====
11 kV	_____
132 kV	=====
220 kV	=====

Sketch-2

Interconnection Study of
Mirpurkhas Energy Limited PP

Power Planners International

DATE 2016	SHEET 1	DWG NO. MEL Sketch-2.DWG	REV
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