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**GENERATION LICENSE APPLICATION
FOR NEW BAGASSE BASED CO-
GENERATION POWER PROJECT
BY
HSM ENERGY LIMITED**



HSM Energy Limited

3RD/4TH FLOOR, IMPERIAL COURT, DR. ZIAUDDIN AHMED ROAD, KARACHI-75530 (PAKISTAN)

Ref: HSMEL/01/2017

May 23, 2017

SCHEDULE I

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

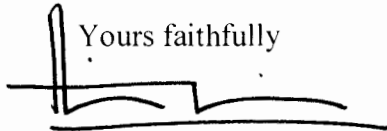
Subject: Application for Generation License

I, Amir Bashir Ahmed, Chief Executive, being the duly authorized representative of *HSM Energy Limited* ("HSMEL") by virtue of Resolution of Board of Directors dated May 20, 2017 hereby apply to the National Electric Power Regulatory Authority for the grant of Generation License to HSMEL pursuant to Section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

I hereby 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 Bankers' Cheque No. 03559535 dated May 23, 2017 drawn on Bank AL Habib, of Rupees three hundred thousand three hundred and thirty six only (PKR 300,336/-), 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 enclosed herewith.

Yours faithfully


Amir Bashir Ahmed
Chief Executive Officer





HSM Energy Limited

3RD/4TH FLOOR, IMPERIAL COURT, DR. ZIAUDDIN AHMED ROAD, KARACHI-75530 (PAKISTAN)

EXTRACTS OF THE MINUTES OF THE MEETING OF THE BOARD OF DIRECTORS OF HSM ENERGY LIMITED HELD ON MAY 20, 2017

The Board of Directors of HSM ENERGY LIMITED, a public unlisted Company duly formed and registered under the laws of Pakistan having Incorporation No. 0108514 with its registered office at 3rd Floor, Imperial Court, Dr. Ziauddin Ahmed Road, Karachi, in their meeting held on May 20, 2017 passed the following resolutions:

RESOLVED that the Chief Executive, the Chief Financial Officer and the Company Secretary be and are hereby singly authorized to apply to National Electric Power Regulatory Authority (NEPRA) for Generation License under the Regulations of Generation, Transmission and Distribution of Electric Power Act, 1997.

FURTHER RESOLVED, that the Chief Executive Officer, the Chief Financial Officer and the Company Secretary be and are hereby empowered and authorized to:

- A) do any or all of the necessary acts, deeds and things, on behalf of the Company, in connection with the application to be filed with NEPRA under the Regulations of Generation, Transmission and Distribution of Electric Power Act, 1997 and the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999.
- B) represent the Company before any of the Government authority including AEDB, NEPRA, CPPA, NTDC, HESCO etc. and to 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.
- C) appoint consultant, advisor, attorney and or any other person to represent the Company before any of the Government authority including AEDB, NEPRA, CPPA, NTDC, HESCO etc. and to 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.
- D) do all acts, deeds and things, which are ancillary and incidental to the afore-said purposes.

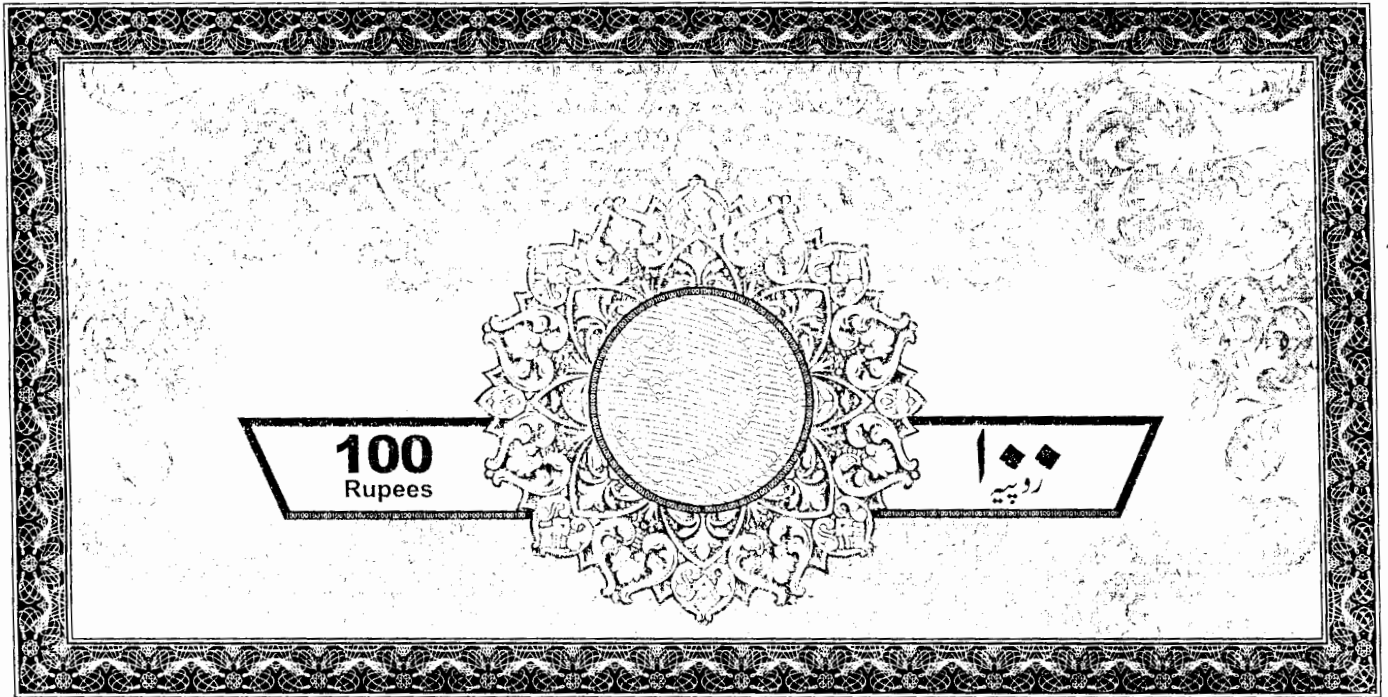
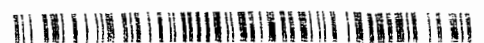
FURTHER RESOLVED, that extracts of these resolutions be provided to the concerned authorities with seal/stamp duly affixed thereon.



Certified True Copy

Chief Executive Officer

May 23, 2017



MOHAMMAD UMER STAMP VENDOR
Lic # 14, Shop # 114, New Ruby Center
Talpur Road, Boultan Market, Karachi.

20 MAY 2017

(RUPEES ONE HUNDRED ONLY)

S.No. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100
Issue to With Address
Through with Address
Purpose
Value Rs.
Stamp Vendor's Signature
(NOT USE FOR FEE WILL & INVOICE PURPOSE)
Vendor Not Responsible for Fake Documents

[Handwritten signature]

BEFORE THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY

AFFIDAVIT

I, Amir Bashir Ahmed S/o Bashir Ahmed having CNIC No. 42501-8318603-7, Chief Executive Officer of HSM 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.

[Handwritten signature of Amir Bashir Ahmed]

DEPONENT

Amir Bashir Ahmed

Chief Executive Officer

CNIC# 42501-8318603-7



A028271



SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE, KARACHI

CERTIFICATE OF INCORPORATION

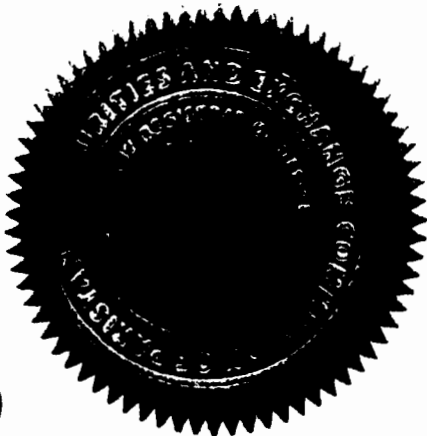
[Under section 32 of the Companies Ordinance, 1984 (XLVII of 1984)]

Corporate Universal Identification No. 0108514

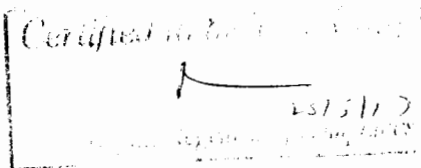
I hereby certify that **HSM ENERGY LIMITED** is this day incorporated under the Companies Ordinance, 1984 (XLVII of 1984) and that the company is limited by shares.

Given under my hand at Karachi this Sixteenth day of May, Two Thousand and Seventeen.

Incorporation fee Rs. 2,000/= only



(Kashif Mahmood)
Deputy Registrar of Companies



THE COMPANIES ORDINANCE, 1984

(COMPANY LIMITED BY SHARES)

MEMORANDUM OF ASSOCIATION

OF

HSM ENERGY LIMITED

- I. The name of the company is HSM 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 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, hydel, hydro, coal, steam, indigenous bagasse and any other bio-mass 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 and to sell power to utility companies. Power distribution networks, organization in power sector, industrial, commercial and other users, corporate bodies autonomous or semi-autonomous corporations or authorities or local bodies or public or private companies or any other organizations, within or outside the country.
 2. To set up and operate power generation and supply of energy from geo-thermal, tidal, biological including agriculture, aquaculture, agri-farming, cattle farming, poultry farming, shrimp farming and producing feed and fodder; agricultural crops and their processing and to construct, establish and fix necessary power stations, cables, wires, lines and works to generate, accumulate and supply/distribute electricity and light to industries, cities, towns, buildings and places both public and private and for all other purposes for which electric energy can be employed.
 3. 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, markets, theaters, buildings, industries, utilities and places both public and private and for all other purposes for which energy can be employed.

4. To generate, produce and sell power to utility companies, power distribution networks, and organizations in the power sector, within and outside the country.
5. 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 semi-autonomous 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, 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.
6. To explore, produce, extract, refine, process, store, transport, distribute, market and sell all kinds of natural resources including but not limited to crude oil, lubricants, fuels, LPG, LNG, Natural Gas, electricity, crops, livestock, agriculture and aquaculture produce and products.
7. To carry on the business of carriers by land or by water or by air (as owners, charterers or otherwise), warehousemen and wharfingers, port handlers, shiphandlers, port operators, terminal operators and to import, export, buy, sell, trade in manufactured, semi-manufactured, and mill supplies, engines, fire-engines, vehicles, machinery, tools, machine shops, electric supplies, appliances, foundry and factory supplies, hard-wares of all kinds and chemical substances useful for the Company.
8. To purchase, acquire and takeover all or any part of the business, properties and assets undertaking and liabilities of any other business carried on by any person, firm or company having similar objects of this company, alongwith the name, goodwill, licences, quotas, tenancy rights, agencies, concession, or any other rights and privileges which the Company may think necessary or convenient for the purposes of its business.
9. 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.

10. 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 provisions of Section 195 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, or 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 mean 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.
11. To borrow or raise monies from members, directors and from financial institutions or without securities or secure by liquid assets, debentures, perpetual or terminable or otherwise issued at par or at a premium or discount or by mortgage, hypothecation, pledge or other assets, present or future of the Company.
12. To take on lease, hire purchase or acquire by license or otherwise, any land, plantations, rights over or connected with lands, buildings, mills, factories, plant, machinery, apparatus, works, lorries, wagons, carts, livestock, stock-on-trade, rights, privileges and movable or immovable property of any description which may be deemed convenient or necessary for any business which the Company is authorized to carry on.
13. To acquire, construct, improve, develop, exchange, lease, mortgage, pledge, sell or otherwise dispose of the whole or any part of the undertakings of the Company or any lands, business, property rights of any kind in the Company or any share or interest therein respectively in such manner and for such consideration as the Company may think fit and in particular for shares, debentures of any other corporation or company having object altogether or in part similar to those of the Company.
14. To enter into any arrangements with the Government of Pakistan or any local government or with any supreme, national, municipal or local authority, or with any person and place where the Company may have interest that may seem 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 it desirable to obtain and to carry out, exercise and comply with any such arrangements, rights, privileges and concessions.
15. 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.

16. To undertake business in the areas relating to hydel, thermal, solar, energy and wind power installations, controls, protection, communication and instrumentation system for power plant, substations, industrial installation and pumping compressor stations, energy conversion system.
17. 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.
18. To act as electrical/mechanical/civil work contractors to local and foreign Governments, agencies, authorities, municipalities, autonomous corporations, private and public companies in power sector.
19. To borrow, procure, raise money in local or any foreign currency from banks, financial institutions, non-banking finance companies, group company (ies) and or avail finances under any Islamic financing scheme and to borrow, procure, or to secure the money in such manner as the Company may deem fit and particularly by mortgage or hypothecation of its property in full or in part or both the present and future assets or 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 and generally to borrow or procure money for the purposes of the business of the Company in such manner as the Company may deem fit, including by issue of debentures, bonds, securities, Participation Term Certificates, Term Finance Certificates, either permanent or redeemable or repayable, or convertible into shares and to secure any securities of the Company by a trust or other assurances.
20. To own, establish, run and maintain offices, branches and agencies all over Pakistan or elsewhere for the development of business of the Company.
21. To invest 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 an investment company or any other unlawful business.
22. To create any depreciation fund, reserve, fund, sinking fund or other funds, whether for depreciation or for repairing, improving, extending or maintaining any or all properties of the Company or for redeemable debentures or for any other purpose whatsoever conducive to the interest of the Company.

23. To pay all or any costs, charges, brokerage, commission and expenses, preliminary and incidental to the promotion, formation, establishment and registration of the Company.
24. To enter into any arrangements with any government or authorities, supreme, municipal, local or otherwise, that may seem conducive to the Company's objects or any of them and to obtain from any such government or authority, any rights, privileges and concessions which the Company may think desirable to obtain, and to carry out, exercise, and to comply with any such arrangements, rights, privileges, and concessions.
25. To enter into agreements and contracts with Water and Power Development Authority or any other authority authorised to buy power and other bulk purchasers for the sale of electricity produced by the Company.
26. To carry on the business of electrical engineers, electricians, engineers and contractors, shopkeepers, agents and manufacturers of electrical apparatus and equipment of every kind and nature.
27. To adopt such means of making known the products of the Company as may seem expedient and in particular by advertising in any media, or by the purchase, exhibition, or reproduction of works of art, or by the publication of books and pictures, or by granting concessions, prizes, rewards, and goods, free or at reduced prices, or in such other manner, whether similar to the above or not, as the Company may deem desirable.
28. To construct, purchase, acquire, lease, build, erect, install, establish, operate, manage and maintain plants, factories, warehouses, workshops, offices, sheds, laboratories, equipments, apparatus and other facilities for the manufacture, refining, processing, storage, sale and distribution of products, equipment and merchandise of all and every kind and nature.
29. To apply for, obtain, register, purchase, lease or otherwise to acquire, and to hold, use, own, operate and introduce and to sell, assign or otherwise dispose of any trade-marks, trade-names, copyrights, patents, inventions, improvements and secret processes' to use, exercise, develop and grant licenses in respect thereof, or otherwise turn to account any such trade-marks, copyrights, patents, licenses, processes and the like or any such property or rights, necessary and incidental to these purposes.
30. To construct, erect and build structures and buildings and any other works or conveniences which may seem directly or indirectly conducive to any of the objects of the Company.
31. To sell, exchange, mortgage or let on lease or royalty all or any of the property of the Company and to grant licenses, easements, options or other rights over the same and to accept such consideration as may be thought fit for the same.

32. To construct and provide or otherwise acquire, whether by purchase, lease or otherwise, residential accommodation for persons employed by or engaged in the business of the Company.
33. To advertise all or any of the manufactures or products of the Company in any way that may be thought advisable, including the posting of bills in relation thereto, and the issue of books, pamphlets and price lists, and the conducting of competitions and the giving of prizes therefor.
34. To enter into working arrangements of all kinds with other companies, corporations, firms or persons, and also to make and carry into effect arrangements with respect to union of interests or amalgamation, either in whole or in part, or any other arrangements with any other companies, corporations, firms or persons, but in any event not to act as managing agents.
35. To obtain all powers and authorities necessary to carry out or extend any of the objects herein.
36. To apply for and obtain any orders, licences and sanctions of any Government, department or Ministry for any of the purposes within the objects of the Company.
37. To enter into any arrangements and to take all necessary or proper steps with the Government of Pakistan and with any provincial government or any foreign government or public authority, local, municipal or otherwise or with any corporation or private persons or all or any of these for the purposes of directly or indirectly carrying out the objects of the Company or effecting any modification in the constitution of the Company or furthering the interests of the Company and to oppose any such steps taken by any other authority, firm or person which the Company considers likely, directly or indirectly, to prejudice its interests, and to obtain or endeavour to obtain from any such governmental or other public authority any charters, contracts, decrees, rights, grants, loans, subsidies, privileges, concessions, indemnities, sanctions or consents as the Company may think proper.
38. Only in connection with the business of the Company, to draw, make, accept, discount, endorse, execute and issue promissory notes, bills of exchange, hundies, bills of lading and other negotiable or transferable securities and to advance or deposit money, securities or property to any persons, firm or company and on any terms with or without security and to lend moneys to the Company's executives, officers and employees/agents/ customers in any event not to act as an investment, banking or finance company.
39. To invest any moneys of the Company not for the time being required for any of the purposes of the Company in such investment (other than shares of stocks in the Company) as may be thought proper and to hold, sell or otherwise deal with such investments but in any event not to act as an investment company.

40. In connection with the business of the Company only, to borrow and secure the payment of money in such manner as the Company shall think fit and in particular by the issue of debentures, participation term certificates, term finance certificates and other securities charged upon all or any of the Company's property, both present and future, and to purchase, redeem and pay off any such securities.
41. To apply for, purchase or otherwise acquire and protect, prolong, and renew whether in Pakistan or elsewhere any patents, patent rights, brevets d'invention, trade marks, licenses, protections, concessions and the like conferring any exclusive or non exclusive or limited right to use the same or any secret or other information as to any invention, process or privilege which may seem capable of being used for any of the purposes of the Company or the acquisition of which may seem calculated directly or indirectly to benefit the Company and to use, exercise, develop, manufacture under or grant licenses or privileges in respect of, or otherwise turn to account the property, rights and information so acquired and to carry on any business in any way connected therewith.
42. To expend money in experimenting on and testing and in improving or seeking to improve any patents, rights, inventions, discoveries, processes, or information of the Company or which the Company may acquire or propose to acquire.
43. To form, incorporate or promote any company or companies whether in Pakistan or in any foreign country, having amongst its or their objects the acquisition of all or any of the assets or control, management or development of the Company or any other objects or object which in the opinion of the Company could or might directly or indirectly assist the Company in the management of its business or the development of its properties or otherwise prove advantageous to the Company and to pay all or any of the costs and expenses incurred in connection with any such promotion or incorporation and to remunerate any person or company in any manner it shall think fit for services rendered or to be rendered in obtaining subscriptions for or placing or assisting to place or to obtain subscription for or for guaranteeing the subscription of or the placing of any shares in the capital of the Company or any bonds, debentures, modaraba certificates, obligations or securities of the Company or any stock, shares, bonds, debentures, obligations or securities of any other company held, or owned by the Company or in which the Company may have an interest or the promotion or formation of any other company in which the Company may have an interest.
44. 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, as permissible under the law.
45. To enter into partnership or into any arrangement for sharing profits or into any union of interests, joint venture, reciprocal concession or co-operation with any person or persons or company or companies, firms, corporations or institutions carrying on or engaged in, or about to carry on or engage in, or being authorized to carry on or engaged in any business or transaction which this Company is

authorized to carry on or engage in or any business or transaction capable of being conducted so as directly or indirectly to benefit this Company.

46. To grant pensions, allowances and bonuses to employees (including directors) or ex-employees of the Company including payment of premiums on life policies of employees of their dependents, to establish and operate Provident Funds for the same and to establish and support or aid any schools and any educational, scientific, literary, religious or charitable institutions or trade societies whether such societies be solely connected with the trade carried on by the Company or not, and any club or other establishment calculated to advance the interest of the Company or its employees.
47. To pay any premiums or salaries and to pay for any property, rights or privileges acquired by the Company or for services rendered in connection with the promotion of objects or the business of the Company or in connection with the acquisition of any property rights, or privileges for the Company or otherwise howsoever, either wholly or partially in cash or in shares, bonds, debentures or other securities of the Company and to issue any shares, bonds, debentures or other securities as fully paid up and to charge any such bonds, debentures or other securities upon all or any part of the property of the Company.
48. 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.
49. To distribute all or any of the property of the Company amongst the members in specie or kind, but so that no such distribution amounting to an unlawful reduction of capital be made.
50. To establish and maintain agencies, branches or depots and to carry on the business in any part of Pakistan or in any part of the world and to take such steps as may be necessary to give the Company such rights or privileges in any part of the world as are possessed by local corporations or partnership firms as may be thought best.
51. To provide services to any business or concern that the Company may find convenient or advantageous and to do any kind of commercial business but in any event not to act as an investment, banking and finance company or engage in any unlawful business.
52. To amalgamate, consolidate, or merge, with a view to effecting a union of interests, either in whole or in part with or into any other companies, associations, firms or persons carrying on any trade or business of a similar nature to that which this Company is authorized to carry on.
53. To pay all cost, charges and expenses which the Company may lawfully pay with respect to the formation and registration of the Company.
54. To do all or any of the things herein in any part of the world either as principals or agents and either alone or in conjunction with others.

55. 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.
56. To do all and everything necessary, suitable or proper or incidental or conducive to the accomplishment of any of the purposes or the attainment of any of the objects or the furtherance of any of the powers hereinbefore set forth, either alone or in association with other corporate bodies, firms or individuals and to do any other act or thing incidental or appurtenant to or arising out of or connected with the business or powers of the Company or part thereof, provided the same be lawful.
57. To purchase, erect, construct, work, equip, maintain, improve or alter, or assist in the purchase, erection, construction, working, equipment, maintenance, improvement or alteration of any mills, factories, works, plants, machineries, scrapers, cutters, crushers, pressers and engines, buildings, offices, warehouses, dwelling houses, labour lines, places of worship, schools, hospitals, dispensaries, canteens, shops, clubs, recreation rooms and grounds, gardens, farms, water courses, tanks, wells, reservoirs, aqueducts, canals, telegraphs, roads, railways, tramways, sidings, bridges, slips, gridirons, lorries, cars, wagons, carts, and other works and conveniences which the Company may think directly or indirectly conducive to any of its objects.
58. To purchase, charter, hire, build or otherwise acquire steam or other ships or vessels, steam launches, flats, barges and cargo boats, trucks, trailers, pickups, bowsters, buses, coaches, with all equipments and furniture and to employ the same in conveyance of passengers, mail, troops, munition of war, meats, live-stock, grain and other agricultural produce and treasure, and also goods and merchandise of description and species by sea and inland waters including rivers and tributaries and by land and also to from any ports or places whatsoever, whether inland, sea-board Pakistani or foreign, to take vessels, flats, barges and other craft into of its vessels as the company may from time to time determine and to acquire postal subsidies, and enter into mail or other contracts and generally to carry on business of carriers by sea any land.
59. To purchase, take on lease or otherwise acquire any lands, mines, mining rights, metalliferous, calcareous or any other land and any interest therein and to explore, work, exercise, develop and to turn to account the same.
60. To crush, win, get, quarry, smelt, calcine, refine, dress, amalgamate, manipulate and prepare for market all metal, cement, lime and mineral and calcareous substances of all kinds and to carry on any other metallurgical operations whatsoever.
61. To cultivate, grow, produce or deal in any vegetable products for the time being required for any of the manufactures which the Company is authorised to undertake, and to carry on all or any of the business of farmers, dairymen, milk contractors, daily farmers, millers, purveyors and vendors of milk, cream, cheese, butter, poultry and provisions of all kinds, growers and dealers in corn, hay and straw, seedmen

and nurserymen, and to buy, sell and trade in any goods usually traded in any of the above businesses, or any other business associated with the farming interest which may be advantageously carried on by the Company.



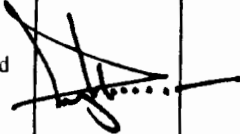

62. To install the biometric verification system of NADRA for the verification of the CNICs of the customers at the time of booking their parcels.
63. Nothing hereinabove contained shall be construed to allow the Company to do the banking, insurance, leasing or any other unlawful business.
64. Notwithstanding anything stated in any object clause, the company shall obtain such other approval or licence from the competent authority, as may be required under any law for the time being in force, to undertake a particular business.
65. 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.

AND is hereby declared that the word "COMPANY" (save when used in reference to this Company) in this clause shall be deemed to include any partnership or other body of persons whether incorporated or not and wherever domiciled and that the object set forth in any sub-clause of this clause shall not except when the context expressly so required, be in any wise limited or restricted by reference to or inference from the terms of any other sub-clause, or by the name of the Company. None of such sub-clauses or the object therein specified or the powers thereby conferred shall be deemed subsidiary or auxiliary. And the Company shall have full power to exercise from time to time all or any of the powers conferred by any part of any sub-clause of this clause in any part or parts of the world.

IV. The Liability of the members is limited.

V. The Authorised Share Capital of the Company is 100,000 (Rupees One Hundred Thousand only) divided into 10,000 (Ten thousand only) Ordinary Shares of Rs. 10/- (Rupees Ten only) each with the rights, privileges and conditions attaching thereof as are provided by the regulations of the Company for the time being with power to increase and reduce the capital of the Company as may for the time being be provided by the Articles of Association of the Company.

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

Names & Surname (Present & Former) on Block Letters	Father's / Husband Name in full	Nationality with any Former Nationality	Occupation	Residential Address in full	Number of shares taken by each subscriber	Signature
Habib Sugar Mills Limited Through: Mr. Asghar D. Habib 42201-5320795-5	Incorporation No. CUIN - 02673 (Late) Dawood Habib	Pakistani	-	3 rd Floor, Imperial Court, Dr. Ziauddin Ahmed Road, Karachi	8,500 (eight thousand five hundred only)	
Mr. Asghar D. Habib 42201-5320795-5 (Nominee of Habib Sugar Mills Limited)	(Late) Dawood Habib	Pakistani	Business/ Industrialist Karachi	ST-25/D, KDA Scheme No. A-1 Karachi	500 (five hundred only)	
Mr. Murtaza Habib 42000-3013439-3 (Nominee of Habib Sugar Mills Limited)	(Late) Hussain D. Habib	Pakistani	Business/ Industrialist Karachi	A/36/B, KDA Scheme No. 1 Karachi.	500 (five hundred only)	
Mr. Amin Ali 42301-1079410-5 (Nominee of Habib Sugar Mills Limited)	Mr. Abdul Hamid	Pakistani	Business/ Industrialist Karachi	278-D, Block A, KDA Scheme No. I-A Karachi	500 (five hundred only)	
Total					10,000 (Ten thousand only)	

Dated 12th day of May 2017

Witness to the above Signatures

Syed Ali Niaz Akhtar Naqvi
S/O. (Late) Syed Hasan Akhtar
Private Service
4th Floor, Imperial Court,
Dr. Ziauddin Ahmed Road
Karachi.

THE COMPANIES ORDINANCE, 1984

(COMPANY LIMITED BY SHARES)

ARTICLES OF ASSOCIATION

OF

HSM ENERGY LIMITED

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 they are repeated or contained in these Articles.

2. The marginal notes hereto shall not affect the construction hereof and in these presents, unless there be something in the subject or context inconsistent therewith:

"Articles" mean the Articles of Association of the Company as originally framed or as altered from time to time.

"Books and papers", "Books or papers", "Books" and "Books of accounts" include accounts, deeds papers, etc. vouchers, registers, writing and documents.

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

"Chief Executive" means the Chief Executive appointed under these Articles.

"Commission" means the Securities and Exchange Commission of Pakistan established under Section 3 of Securities and Exchange Commission of Pakistan Act, 1997.

"Company" means **HSM ENERGY LIMITED**.

"Debentures" include stock, bond, term finance certificate and any other security other than the shares of the Company whether constituting a charge on the assets or not.

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

"Dividend" includes bonus.

"Document" includes summon, notice, requisition, order, other legal process, voucher and register.

"Financial statements" includes the balance sheet, profit and loss account, notes and other statements and explanatory material which are identified as being part of the financial statements and are required to be prepared under the Ordinance.

"Modaraba Ordinance" means the Modaraba Companies and Modaraba (Flotation and Control) Ordinance, 1980 as thereof for the time being in force.

"Month" means calendar month.

"Member" means the member of the Company within the meaning of the provisions of Section 2(1) (21).

"Ordinance" means the Companies Ordinance, 1984 including any statutory modification for the time being in force.

"Office" means the registered office for the time being of the Company.

"Participatory Redeemable Capital" means such capital as is entitled to participate in the profit and loss of the Company.

"Proxy" includes Attorney duly constituted under a Power of Attorney.

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

"Registrar" means the Registrar of Companies.

"Redeemable Capital" has the meaning assigned to it by Section 2(1) (30A) of the Ordinance.

"Section" means Section of the Ordinance.

"Special Resolution" has the meaning assigned to it by Section 2(1) (36) of the Ordinance.

"Secretary" means any individual appointed to perform the secretarial, administrative or other duties ordinarily performed by the secretary.

"Share" means share in the capital of the Company.

"Security" means any share, scrip, debenture, participation term certificate, term finance certificate, bond, pre organization certificate or such other instrument as the Federal Government by notification in the official gazette specify for the purpose.

"In writing" and "Written" include printing, lithography, and other modes of representing or reproducing words in a visible form.

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

Words importing the masculine gender also include the feminine gender.

Words importing persons include corporations.

3. Regulations for management of the Company and for observance of members thereof and their representatives shall (subject to any exercise of statutory power of the Company in reference to repeal or alternation of or additions to its regulations by Special Resolution, as prescribed by the Ordinance) be such as are contained in these Articles, shall be read in conjunction with the Ordinance and provisions of any other law for the time being in force.

SHARES

4. The authorized Capital of the Company is Rs. 100,000/- (Rupees One hundred thousand only) divided into 10,000/- (Rupees Ten thousand only) ordinary shares of Rs. 10/- each.
5. Subject to the provisions of these Articles, 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 think fit and either at par or at a premium, or at a discount (subject to the provisions of Section 84) and for such time, and for such consideration as the Directors think fit.
6. (a) As regards all allotments from time to time made, the Directors shall duly comply with the requirements of Section 73.
(b) The minimum subscription at which the directors shall proceed to allotment of shares shall be Rs. 100,000.
7. The Director shall comply with the provisions of Section 68 with regard to restriction on allotment
8. The Company may issue ordinary shares or grant option to convert into shares the outstanding balance of any loans, advances or credit, as defined in the Banking Companies Ordinance, 1962 (LVII of 1962) or other non interest bearing securities and obligations in accordance with the provisions of Section 87.
9. The Company may issue to one or more scheduled banks, financial institution or such other persons as are specified for the purpose by the Federal Government by notification in the official gazette, any investment in the nature of redeemable capital in any or several forms in accordance with the provisions of Section 120.
10. Shares in the capital of the Company may be allotted as payment or part payment for any property sold or transferred, goods or machinery supplied or for services rendered to the Company or conduct of its business, and any shares which may be so allotted, may be issued as fully paid up otherwise than in cash, and if so issued shall be deemed to the fully paid up shares as aforesaid.
11. The Company may at any time pay a commission to any person for subscribing or agreeing to subscribe (whether absolutely or conditionally) for any shares, debentures or debenture stocks in the Company or procuring or agreeing to procure subscriptions (whether absolute or conditional) for any shares, debentures or debenture stock in the Company, and the amount or rate of commission shall not exceed such rate percent of amount as may be fixed under any law or by the Commission on the shares, debentures

or debenture stock in each case subscribed or to be subscribed. The commission may be paid or satisfied in cash or in shares, debentures or debenture stock.

12. The Company may pay a reasonable sum for brokerage not exceeding the limit imposed by any law for the time being in force or by any regulatory authority.
13. With the previous authority of the Company in General Meeting and the sanction of commission and upon complying with Section 84 it shall be lawful for the Directors to issue at a discount shares of a class already issued.
14. Save as herein otherwise provided, the Company shall be entitled to treat the registered holder of any share as the absolute owner thereof and accordingly shall not, except as ordered by a Court of competent jurisdiction or as by statute required, be bound to recognize any benami, equitable or other claim to or interest in such share on the part of any other person.
15. Shares may be registered in the name of any limited company or other corporate body. Not more than four persons shall be registered as joint holders of any share.

CERTIFICATES

16. The certificates of title to shares and duplicates thereof when necessary shall be issued under the Common Seal of the Company and bear the signatures of one Director and shall be counter signed by a second director.
17. Every member shall be entitled without payment to one certificate for all the shares registered in his name or if the Directors so approve to several certificates each for one or more of such shares but in respect of each certificate for less than five hundred shares, the Directors shall be entitled to charge a fee as they may determine. Every certificate of shares shall specify the number and distinctive number of the shares in respect of which it is issued and the amount paid up thereon.
18. The Company shall, within ninety (90) days after the allotment and within forty five (45) days after the application for the registration of the transfer of any share, complete and have ready for delivery the certificates for shares and unless sent by post or delivered to the person entitled thereto, within that period, shall give notice of this fact to the shareholder immediately thereafter.
19. If any certificate be worn out or defaced, then, upon production thereof to the Directors they may order the same to be cancelled, and may issue a new certificate in lieu thereof, and if any certificate be lost or destroyed then, upon proof thereof, to the satisfaction of the Directors and on such indemnity as the Directors deem adequate being given, a new certificate in lieu thereof shall be given to the registered holder of the shares within forty five (45) days from the date of application, to which such lost or destroyed certificate shall relate.
20. For every certificate issued under the last preceding Article there shall be paid to the Company a sum as the Directors may determine.

21. The certificates of shares registered in the name of two or more persons shall be delivered to the person first named on the Register.

TRANSFER AND TRANSMISSION

22. (a) Application for the registration of transfer of shares may be made either by the transferor or transferee.
- (b) Subject to the provisions of Section 76(1) and 76(5) no transfer of shares shall be registered unless a proper instrument of transfer 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 share shall be signed both by the transferor and transferee, and shall contain the name and address both of the transferor and transferee, and the transferor shall be deemed to remain the holder of such share until the name of the transferee is entered in the Registers in respect thereof. Each signature to such transfer shall be duly attested by the signature of the credible witness who shall add his address and occupation.
23. The instrument of transfer of any share shall be in writing in the usual common form, or in the following form, or as near thereto as circumstances will admit:

I, _____ of _____ in consideration of the sum of Rs. _____ paid to me by _____ of _____ hereinafter called the said transferee, do hereby transfer to the said transferee share (or shares) numbered _____ in the undertaking called to hold into the said transferee, his executors, administrators and assigns, subject to the several conditions on which I held the same immediately before the execution hereof, and I, the said transferee do hereby agree to take the said share (or shares) subject to the conditions, aforesaid.

As witness our hands the _____ day of _____ Witness to the signature of, etc.

24. No transfer shall be made to a person of unsound mind or to an insolvent.
25. Every instrument of transfer shall be left at the office for registration, accompanied by the certificate of the shares to be transferred, and such other evidence as the Directors may require to prove the title of the transferor or his right to transfer the shares, and upon payment of the proper fee, the transferee shall be registered as a member in respect of such shares. The Directors may waive the production of any certificate upon evidence satisfactory to them of its loss or destruction.
26. The Directors shall not refuse to register the transfer of any shares unless the transfer deed is defective or invalid. The transfer deed may be re-lodged after the removal of such defect or invalidity.

27. All instruments, of transfer which shall be registered shall be retained by the Company, but any instrument of transfer which the Directors may decline to register, due to any defect in or invalidity of the transfer deed shall be returned to the person depositing the same.
28. If the Directors refuse to register the transfer of any shares, they shall within thirty days from the date on which the instrument of transfer was lodged with the Company send to the transferee and the transferor notice of the refusal stating the reasons for such refusal.
29. A fee as fixed by the Board from time to time may be charged for each transfer, and shall, if required by the Directors, be paid before the registration thereof.
30. On giving seven day's previous notice in the manner provided in Section 151 the Transfer Books and Register of Members may be closed during such time as the Directors think fit, not exceeding in the whole, forty-five days in each year, but not exceeding thirty days at a time.
31. A person may on acquiring interest in the Company as a member, represented by shares, at any time after acquisition of such interest, deposit with the Company a nomination conferring on one or more persons the right to acquire interest in the shares specified therein in the event of his death. The Company shall also comply with the provisions of Section 80 in case of any such nomination.
32. The executors or administrators of a deceased Member (not being one of several joint holders) shall be the only person recognized by the Company as having any title to the shares registered in the name of such member and in case of the death of any one or more of the joint holders of registered shares, the survivors shall be the only persons recognized by the Company as having any title to or interest in such shares.
33. Before recognizing any executor or administrator the directors may require him to obtain a Grant of Probate or Letters of Administration or other legal representation, as the case may be, from some competent court in Pakistan provided nevertheless that in any case where the Board in their absolute discretion thinks fit. 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 in their absolute discretion, may consider necessary.
34. Any person becoming entitled to a share in consequence of death lunacy or insolvency of a Member may, upon evidence as to his title being produced, as may from time to time be required by Directors, elect either to be registered himself as holder of share or to have some other person nominated by him registered as transferee thereof as holder of share or to have some other person nominated by him registered as transferee thereof as deceased or insolvent person could have opted. If a person so becoming entitled shall elect to be registered himself, he shall deliver or send to the Company a notice in writing signed by him, stating that he so elects, if he shall elect to have another person registered he shall testify his election by execution to that person a transfer of share.
35. A person becoming entitled to a share by reason of death or insolvency of holder shall be entitled to same dividends and other advantages to which he would have been entitled

if he were registered holder of share except that he shall not, before being registered as a member in respect of share, be entitled to exercise any right conferred by membership in relation to meetings of the Company.

36. Any committee or guardian of a lunatic or infant member or any person becoming entitled to or to transfer shares in consequence of the death or bankruptcy or insolvency of any member upon producing such evidence that he sustains the character in respect of which he proposes to act under this Article, or of his title as the Directors think sufficient, may, with the consent of the Directors (which they shall not be under any obligation to give), be registered as a member in respect of such share, or may, subject to the regulations as to transfer herein before contained, transfer such share.

INCREASE, ALTERATION AND REDUCTION OF CAPITAL

37. The Company may from time to time by Ordinary Resolution increase the capital by the creation of new shares of such amount as may be deemed expedient.
38. Where the Directors decide to increase the capital of the Company by the issue of further shares, such shares shall be offered to the members strictly in proportion to the existing shares held by each member, irrespective of class, and such offer shall be made by notice specifying the number of shares to which the member is entitled, and limiting a time within which the offer, if not accepted, will be deemed to be declined. Such offer shall be accompanied by a circular duly signed by the Directors or an officer of the Company authorized by them, in the form prescribed by the Commission containing material information about the affairs of the Company, latest statement of accounts and setting forth the necessity for issue of further capital. The circular shall specify a date by which the offer, if not accepted, will be deemed to be declined.
39. Where the offer of new shares made to the member in pursuance of Section 86 is declined or not subscribed either in whole or in part, such whole or part shall be allotted and issued in such manner as the Directors may deem fit.
40. The fractional shares shall not be offered to the members becoming entitled to such fractional shares on the issue of new shares. All fractions less than a share shall be consolidated and disposed of by the Company and all the proceeds from such disposition shall be paid to such of the entitled shareholders as may have accepted the offer for new shares.
41. Subject to any special rights or privileges for the time being attached to any issued shares, the new shares shall be issued upon such terms and conditions, and with such rights and privileges annexed thereto as the resolution creating the same shall direct.
42. Before the issue of any new shares, the Company in General Meeting may make provisions as to the allotment and issue of the new shares, and in particulars may determine that the same shall be issued either at par or at a premium or, subject to the provisions of Section 84 at a discount.
43. Except so far as otherwise provided by the conditions of issue or by these presents, any capital raised by the creation of new shares shall be considered part of the Original

capital and shall be subject to the provisions herein contained with reference to the transfer and transmission and otherwise.

44. The right amongst various classes of shares, if any as to profits, votes and other benefits shall be strictly proportionate to the paid up value of shares.
45. The Company may by Special Resolution:
 - (a) consolidate and divide its share capital into shares of a large denomination than its existing shares;
 - (b) sub divide its existing shares or any of them into shares of smaller amount than is fixed by the Memorandum of Association subject, nevertheless, to provisions of paragraph (d) of sub section (i) of Section 92.
 - (c) cancel any shares which, at the date of passing of the resolution have not been taken or agreed to be taken by any person.
46. The resolution whereby any share is subdivided may determine that, as between the holders of the shares resulting from such subdivision, one or more of such shares shall have some preference or special advantage as compared with the others or other, subject, nevertheless, to the provisions of Section 92.
47. The Company may (subject to the provisions of Section 92 and 95 to 106 both inclusive) from time to time by Special Resolution, cancel shares, which at the date of the resolution in that behalf, have not been taken or agreed to be taken by any person or reduce its capital by paying off capital or purchasing capital which has been lost or is unrepresented by available assets or otherwise as may seem expedient.
48. The variation of the rights of shareholders of any class, where such alteration affects the substantive rights or liabilities of members or class of a members shall be carried only if a majority of at least three fourth of the members or class of members affected by such alteration, as the case may be, personally or through proxy vote for such alteration.

VARIATION OF RIGHTS

BORROWING POWERS

49. The Directors may from time to time at their discretion borrow and secure the payment of any sum or sums of money for the purpose of the Company, and may themselves lend to the Company on security or otherwise subject to the provisions of the Ordinance.
50. The Directors may secure the repayment or payment of any sum or sums in such manner and upon such terms and conditions in all respects as they think fit, and in particular:
 - i) by the creation of any mortgage or charge on the undertaking or the whole or any part of the property, present or future, ii) by the issue of bonds perpetual or redeemable debentures or debenture stock or redeemable capital of the Company charged upon all or any part of the property of the Company both present and future, iii) issue of promissory notes, bills of exchange and issuance bills, iv) furnishing guarantees and

undertakings depositing securities, shares and documents of title, and v) appointing attorneys, giving them powers of executing documents, having them registered, selling and managing all the Company's properties, undertakings and business and furnishing or creating such other securities as may be considered expedient; and for all or any of the purposes aforesaid or otherwise execute, complete and deliver such agreements and documents as may be required.

51. Debentures, debenture stock, bonds, redeemable capital or other securities may be made assignable free from any equities between the Company and the person to whom the same may be issued.
52. Any debentures, debenture stock, bonds, redeemable capital or other securities may be issued at a discount, premium or otherwise and with any special privileges as to redemption, surrender, drawings, allotment of shares, attending and voting subject to the provisions of the Ordinance, at General Meetings of the Company, appointment of Directors and otherwise.
53. The Directors shall cause a proper Register to be kept in accordance with Section 135, of all mortgages and charges specifically affecting the property of the Company, and shall duly comply with the requirements of Sections 121 and 123, in regard to the registration of mortgages and charges therein specified, and otherwise and shall also duly comply with the requirements of Section 130 as to keeping a copy of every instrument creating any mortgage or charge by the Company at the office, and the requirements of Section 132 as to giving information of the payment or satisfaction of any charges or mortgage created by the Company.
54. Every Register of holders of debentures of the Company may be closed for any period not exceeding in the whole forty five days in any year and not exceeding thirty days at one time. Subject as aforesaid every such Register shall be open to the inspection of the registered holder of any such debentures and of any member; but the Company may in General Meeting impose any reasonable restrictions so that at least two hours in each day when such Register is open for inspection.
55. Subject to the provisions of Section 76(1) and 76(5) no transfer of registered debentures shall be registered unless a proper instrument of transfer duly stamped and executed by the transferor and transferee has been delivered to the Company together with the Certificate or Certificates of the debentures.
56. If the Directors refuse to register the transfer of any debenture, they shall, within thirty days from the date on which the instrument of transfer was lodged with the Company send to the transferee and the transferor notice of the refusal.
57. The Company shall comply with the provisions of Section 136 as to allowing inspection of copies kept at the office in pursuance of Section 130 and as to allowing inspection the Registers of Mortgages to be kept at the office in pursuance of Section 135.
58. The Company shall comply with the provisions of Section 113 as to supplying copies of any register of holders of debentures or of any trust deed for securing any issue of debentures, on payment of the Statutory fee.

59. Holders of Debentures shall have the same right to receive and inspect the Financial Statements of the Company and the Reports of the Auditors and other reports as are provided to the holders of Ordinary Shares in the Company.

RESERVE AND DEPRECIATION FUNDS

60. The Directors may from time to time before recommending any dividend set apart any and such portion of the profits of the Company as they think fit as a Reserve Fund to meet contingencies or for the liquidation of any debentures, other redeemable capital, debts or other liabilities of the Company, for equalization of dividends or for repairing, improving, and maintaining any of the property of the Company, and for such other purposes of the Company as the Directors in their absolute discretion think conducive to the interests of the Company; and may invest the several sums so set aside upon such investment (other than shares of the Company) subject to the provisions of Section 208 as they may think fit, and from time to time deal with and vary such investments, and dispose of all or any part thereof for the benefit of the Company, and may divide the Reserve fund into such special funds as they may think fit, with full powers to employ the Reserve Funds or any part thereof in the business of the Company, and that without being bound to keep the same separate from the other assets.
61. The Directors may, from time to time before recommending any dividend, set apart any and such portion of the profits of the Company, as they think fit as a Depreciation Fund applicable at the discretion of the Directors, for providing against any depreciation in the investments of the Company or for rebuilding, restoring, replacing or for altering any part of the buildings, work plant, machinery or other property of the Company destroyed, or damaged by fire, flood, storm, tempest, earthquake, accident, riot, wear and tear, or any other means, and for repairing, altering and keeping in good condition the property of the Company, or for extending and enlarging the buildings, machinery, and property of the Company, with full power to employ the assets constituting such Depreciation Fund in the business of the Company, and that without being bound to keep the same separate from other assets.
62. All moneys carried to the Reserve Fund and Depreciation fund respectively shall nevertheless remain and be profits of the Company available subject to due provisions being made for actual loss or depreciation for the payment of dividends and such moneys and all the other moneys of the Company not immediately required for the purposes of the Company may be invested by the Directors in or upon such investment or securities as they may select or may be used as working capital or may be kept at any Bank on deposit or otherwise as the Directors may from time to time think proper subject to the provisions of Section 208.

GENERAL MEETINGS

63. A General Meeting to be called annual general meeting shall be held, in accordance with the provisions of Section 158, 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, a general meeting shall be held on date, time and place as may be determined by the Directors.

The statutory meeting of the Company shall be held in the manner, for the purpose and within the period required by Section 157 of the Ordinance.

64. All General Meetings of the Company other than that referred to in Article 63 shall be called Extra ordinary General Meeting.

65. The Directors may, whenever they think fit, and they shall, on the requisition of the holders of not less than one tenth of the voting power of the Company, forthwith proceed to convene an Extraordinary General Meeting and in the case of such requisition the following provisions shall have effect:

- (1) The requisition must state the objects of the meeting and must be signed by the requisitionists and deposited at the Office, and may consist of several documents in like form, each signed by one or more requisitionists.
- (2) If the Directors of the Company do not proceed within twenty one days from the date of the requisition being so deposited to cause a meeting to be called, the requisitionists, or a majority of them in value, may themselves convene the Meeting, but any meeting so convened shall not be held after three months from the date of the deposit.
- (3) Any meeting convened under the Article by the requisitionists shall be convened in the same manner as nearly as possible as that in which meetings are to be convened by the Directors but shall be held at the Office.
- (4) A requisition by joint holders of shares must be signed by all such holders.

66. Not less than twenty one days notice of every General Meeting to the members specifying the place, day and hour of meeting with a statement of the business to be transacted at the meeting shall be given either by advertisement or by notice sent by post or otherwise served as hereinafter mentioned and where it is proposed to pass a special resolution, the intention to propose such resolution as a special resolution shall be given.

67. Where any special business is to be transacted at a General Meeting, there shall be annexed to the notice of the meeting a statement setting out all material facts concerning such business, including, in particular, the nature and extent of the interest, if any therein of every Director, whether directly or indirectly, and, where any item of business consists of the according of an approval to any document by the meeting, the time when and the place where the document may be inspected shall be specified in the statement.

68. The accidental omission to give any such notice to or the non receipt of notice by any of the members shall not invalidate the proceedings at any such meeting.

PROCEEDINGS AT GENERAL MEETINGS

69. The business of an Ordinary Meeting shall be to receive and consider the Financial Statements, the Reports of the Directors and of the Auditors, to elect Directors in the place of those retiring, to appoint Auditors and fixing their remuneration, to declare dividends and to transact any other business which under these presents ought to be transacted at an Ordinary General Meeting. All other businesses transacted at any Ordinary Meeting or at an Extraordinary Meeting shall be deemed special.

70. The quorum for convening a General Meeting shall be the minimum as provided in sub section (2) of Section 160 of the Ordinance.

71. No business shall be transacted at any General Meeting unless the quorum requisite shall be present at the commencement of the business.
72. The Chairman of the Directors shall be entitled to take the chair at every General Meeting or if there be no such Chairman or if at any meeting he shall not be present within fifteen minutes after the time appointed for holding such meeting, or is unwilling to act, the members present shall choose another Director as Chairman, and if no Director be present or if all the Directors present decline to take the Chair, then the members present shall choose one of their member, being a member entitled to vote, to be the Chairman.
73. If within half an hour from the time appointed for the meeting a quorum be not present, the meeting if convened upon requisition of members shall be dissolved, but in any other case it shall stand adjourned to the same day in the next week at the same time and place, and if at such adjourned meeting a quorum be not present, those members who are present, not being less than two, shall be a quorum and may transact the business for which the meeting was called.
74. Chairman may, with consent of any meeting (and shall if so directed by meeting), adjourn any meeting from time to time and from place to place, but no business shall be transacted at any adjourned meeting other than the business left unfinished at meeting from which adjournment took place. When a meeting is adjourned for twenty two days or more, notice of adjourned meeting shall be given as in case of an original meeting. Save as aforesaid, it shall not be necessary to give any notice of an adjournment or business to be transacted at an adjourned meeting.
75. At any General Meeting a resolution put to the vote of the meeting shall be decided on a show of hands, unless a poll is (before or on the declaration of the result of the show of hands) ordered by the Chairman on its own motion or demanded by at least five members having the right to vote on the resolution present in person or by proxy or any member or members holding not less than one tenth of the issued capital which carries voting rights, or by any member or members present in person or by proxy having not less than one tenth of the voting power in respect of the resolution and unless a poll is so demanded a declaration by the Chairman 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 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 favor of, or against the resolution.
76. The Chairman shall have the power to regulate the manner in which a poll shall be taken. The result of the poll shall be deemed to be the resolution of the meeting at which the poll was demanded. The demand of a poll may be withdrawn at any time. In case of any dispute as to the admission or rejection of a vote, the Chairman shall determine the same, and such determination made in good faith shall be final and conclusive.
77. Any poll duly demanded on the election of a Chairman of a meeting or on a question of adjournment shall be taken forthwith and a poll demanded on any other question shall be taken at such time, not more than fourteen days from the day on which it was demanded, as the Chairman of the meeting may direct.

78. The demand of a poll shall not prevent the continuance of a meeting for the transaction of any business other than the question on which a poll has been demanded.
79. In case of an equality of votes, whether on a show of hand or on a poll, the Chairman of Meeting at which show of hands takes place or at which poll is demanded, shall be entitled to a casting vote in addition to vote or votes to which he may be entitled as Member.

VOTES OF MEMBERS

80. Subject to any special rights or restrictions as to voting upon which any shares may be held, on a show of hands every member present in person or by proxy shall have one vote and upon a poll every member present in person or by proxy shall have one vote for every share held by him, provided that no Company shall vote by proxy so long as resolution of its Directors under the provisions of these Articles is in force.
- 80A. A member may opt for e-voting in a general meeting of the Company under the provisions of the Companies (E-Voting) Regulations 2016 (including any statutory modification thereof), as amended from time to time. In the case of e-voting, both member and non-member can be appointed as proxy. The request to appoint execution officer and option to e-vote through intermediary shall be required to be submitted with the company at the Company's Registered Office or through email at least ten (10) days before holding of the general meeting. The Company will arrange for e-voting, upon receipt of request for e-voting from any member or members having not less than one tenth of the voting power.
81. (1) A Corporation or any other company registered under the Ordinance or under any other repealed Companies Act, where such Corporation or such other Company, is a member of the Company may, by resolution of its directors, authorize any of its officials or any other person to act as its representative at any meeting of the Company and the person so authorized shall be entitled to exercise the same powers on behalf of such Corporation or such other Company if he was an individual shareholder of the Company.
- (2) Any other Corporation or Company which is the creditor of the Company may authorize any of its officials or any other person to act as its representative at any meeting of the creditors of the Company held in pursuance of the Ordinance or any other meeting to which it is entitled to attend in pursuance of the provisions contained in any debenture or trust deed or any other document and the person so authorized shall be entitled to exercise the same power as are available to such Corporation or such other Company which he represents.
82. Any person entitled under the Transmission Article to transfer any shares may vote at any General Meeting in respect thereof in the same manner as if he were the registered holder of such shares, provided that forty eight hours at least before the time of holding

the meeting or adjourned meeting as the case may be at which he proposes to vote shall satisfy the Directors of his right to transfer such shares, or the Directors have previously admitted his right to vote at such meeting in respect thereof. If any member be a lunatic, idiot or non compos mentis, he may vote whether by a show of hands or at a poll by his committee, curator bonis or other legal curator and such last mentioned persons may give their votes by proxy.

83. Where there are joint registered holders of any share any one of such persons may vote at any meeting either personally or by proxy in respect of such share as if he were solely entitled thereto; and if more than one of such joint holders be present at any meeting either personally or by proxy, that one of the said persons so present whose name stands first on the Register in respect of such share shall alone be entitled to vote in respect thereof. Several executors or administrators of a deceased member in whose name any share stands shall for the purposes of this Article be deemed joint holders thereof.
84. Votes may be given either personally or by proxy, or in the case of a company, by a representative duly authorized as aforesaid.
85. 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 such appointer is a corporation under its common seal or the hand of its Attorney. No person shall be appointed as a Proxy who is not a member of the Company and qualified to vote.
86. 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 of 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.
87. A vote given in accordance with the terms of an instrument appointing a proxy shall be valid notwithstanding the previous death or insanity of the principal or revocation of the instrument or transfer of the share in respect of which the vote is given, provided no intimation in writing of the death, insanity, revocation or transfer of the share shall have been received at the office before the meeting. Provided nevertheless that the Chairman of any meeting shall be entitled to require such evidence as he may in his discretion think fit of the due execution of an instrument of proxy and that the same has not been revoked.
88. Every instrument appointing a Proxy shall as nearly as circumstances will admit, be in the form or to the effect given in Article 89 and shall be retained by the Company.
89. An instrument of proxy may be in the following form or in any other Form which the Directors shall approve.

HSM ENERGY LIMITED

Form of Proxy

I, _____ of _____ being a member of _____ hereby appoint _____ of _____ (or failing _____ or failing him _____ of _____) as my Proxy in my absence to attend and vote for me, and on my behalf at the (Ordinary or Extraordinary, as the case may be) General Meeting of the Company to be held on _____, the day at _____ and at any adjournment thereof.

As witness my hand this _____ day of _____ 20 _____

signed by the said.

Provided always that an instrument appointing a Special Proxy may be in the form set out in Regulation 39 of Table "A" of the Ordinance.

HSM ENERGY LIMITED

Form of Proxy for e-voting

I/we _____, being a member of HSM Energy Limited, holder of _____ Share(s) as per Register Folio No. _____ hereby opt for e-voting through Intermediary and hereby give consent for the appointment of Election Officer _____ as proxy and will exercise e-voting as per the Companies (E-Voting) Regulation, 2016 and hereby demand for poll for resolutions.

My secured email address is _____, please send login details, password and electronic signature through email.

Signature of member

(Signature should agree with the specimen signature registered with the Company)

Signed in the presence of: _____

Signature of Witness

Signature of Witness

90. Any member whose name is entered in the Register of Members of the Company shall enjoy the same rights and be subject to the same liabilities as all other members of the same class.

91. No objection shall be made to validity of any vote except at a Meeting or poll at which such vote shall be tendered, and every vote whether given personally or by proxy not disallowed at such Meeting or poll shall be deemed valid for all purposes of such Meeting or poll whatsoever.
92. The Chairman of any Meeting shall be sole judge of validity of every vote tendered at such Meeting and at taking of a poll he shall be sole judge of validity of every vote tendered at such poll.

DIRECTORS

93. The following shall be the first directors of the Company.
 1. Mr. Asghar D. Habib.
 2. Mr. Murtaza Habib.
 3. Mr. Amin Ali.
94. There shall be not less than three Directors nor more than twelve directors of the Company unless the Company is listed at any stock exchange in which case the minimum number of directors shall not be less than seven. The Directors shall fix the number of elected Directors of the Company not later than thirty five (35) days before the convening of the General Meeting at which directors are to be elected, and the number so fixed shall not be changed except with the approval of the General Meeting of Company.
95. No person shall be appointed as a Director of the Company who is ineligible to be appointed as Director on any one or more of the grounds enumerated in Section 187 or any other law for the time being in force.
96. Save as provided in Section 187, a Director shall be a member of the Company. The qualification of a Director, other than a Director representing an interest holding of the requisite value, shall be the holding in his own name solely, or jointly with another or others and whether beneficially or as a Trustee/nominee for another or others or otherwise howsoever, of shares of the nominal value of Rs. 5,000/- (Rupees Five thousand only) in the Company.
97. Election of directors shall be held in accordance with Section 178 of the Ordinance. All the Directors elected shall hold office for three years until earlier resigns or become disqualified or otherwise ceases to hold office. A retiring director shall continue to perform his functions until his successor is appointed. The retiring Directors shall be eligible for re-election.
98. Any person who seeks to contest an election to the office of the Directors, shall, whether he is a retiring Director or otherwise file with the Company, not later than fourteen days before the date of the 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 election withdraw such notice. The notice shall be transmitted by the Company to the members not later than seven days before the date of the meeting at which election are to be conducted.
99. The Directors shall be elected by members of the Company in General Meeting in the following manner, namely:
 - a) a member 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) A member may give all his votes to a single candidate or divide them between more than one of the candidates in such manner as he 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.

100. A Director may resign from his office upon giving one month's notice in writing to the Company of his intention to do so, and such resignation shall take effect upon expiration of such notice or on its earlier acceptance by the Directors.

101. Any casual vacancy occurring among the Directors may be filled up by the Directors, but any person so chosen shall retain his office so long only as the vacating Director would have retained the same if no vacancy had occurred. Provided that the Directors may not fill a casual vacancy by appointing any person who has been removed from the office of a Director of the Company under Article 103.

102. A Director elected in accordance with Article 100 may only be removed by a resolution of the Company in General Meeting but such a resolution shall not be deemed to have been passed if the number of votes against it equals to, or exceeds, the number of votes that would have been necessary for the election of a Director at the immediately preceding election of Directors. A Director so removed shall not be appointed a Director to fill any casual vacancy by the Board of Directors.

103. The office of a Director shall ipso facto be vacated if :

- (a) he becomes ineligible to be appointed a director on any one or more of the grounds enumerated in clauses (a) to (j) of Section 187;
- (b) he or any firm of which he is partner or any private Company of which he is a Director;
 - (i) 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 legal or technical adviser or a banker; or
 - (ii) accepts a loan or guarantee from the Company in contravention of Section 195, or
- (c) 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, or
- (d) he acts in contravention of Sections 196 and 214 of the Ordinance, or
- (e) he commits any offence punishable under the Pakistan Penal Code and being under the provisions of the Criminal Procedure Code non bailable, or

- (f) by notice in writing to the Company he resigns his office, or
- (g) he is removed from office by a Special Resolution of the Company, or
- (h) he suspends payment to or compounds with the creditors.

104. Continuing Directors may act notwithstanding any vacancy in their body, but so that if the number falls below minimum fixed, the Directors shall not, except in emergencies or for the purpose of filling up vacancies or for summoning a General Meeting of the Company, act so long as the number is below minimum and they may so act notwithstanding absence of a necessary quorum under provision of Article 115.

105. Remuneration payable to Directors for attending Board Meeting shall be fixed by the Board of Directors from time to time and shall not exceed the limit imposed by any law for the time being in force and a Director who performs extra services or a full time Director shall receive such remuneration (whether by way of salary, commission, participation in profits, allowances, perquisites, etc., or partly in one way and partly in another) as the Directors may fix, subject to the any modification in that behalf for the time being in force. The Director may also pay to any Director all such reasonable expenses as he may incur in attending and returning from meetings of Directors or committee of Directors or which he may otherwise incur in or about business of the Company.

106. A Director of the Company may be or become a Director of any Company promoted by the Company or in which it may be interested as a vendor, shareholder or otherwise, and no such Director shall be accountable for any benefits received as a Director or member of such Company.

107. Directors shall have power at any time and from time to time to appoint any person as Technical/ Executive Directors and such Technical/ Executive Directors may be appointed only for a fixed period on such special remuneration as may be determined by the Board. The number of such directors appointed shall not be counted within minimum or maximum fixed for number of directors in these Articles. Such Technical/Executive Directors would be the senior executives of the Company and will not have any representation on the Board of the Company unless specially invited by the members of the Board to assist them in the proceedings of the meeting of the Board of Directors of the Company.

108. The Company shall keep at the office a Register of its Directors, Managers and Chief Executive containing the particulars required by Section 205 and the Company shall otherwise comply with the provisions of that Section as regards furnishing returns to the Registrar and allowing inspection of the Register.

109. The Directors nominated under Section 183 of the Ordinance, shall not be subjected to the provisions of these Articles regarding eligibility for appointment, election, retirement, removal, casual vacancy or vocation of office including the provisions of Sections 178, 180 and 181.

110. Subject to the provisions of Section 214 the Directors shall not be disqualified from contracting with the Company either as vendor, purchaser or otherwise nor shall any such contract or arrangement entered into by or on behalf of the Company with any Company

or partnership of or in which any Director shall be a member or otherwise interested be avoided, nor shall any 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 due to the nature of their or his interest must be disclosed by them or him at the meeting of the Directors at which the contract or arrangement is determined or, if the interest is exists, or in any other case at the first meeting of the Directors after the acquisition of the interest. Provided nevertheless that no Director shall take part in the discussion of such contract or arrangement in which he is so interested as aforesaid, and if he does so vote, his vote shall not be counted but he shall be entitled to be present at the meeting during the transaction of the business in relation to which he is precluded from voting although he shall not be reckoned for the purpose of ascertaining whether there be a quorum of Directors present. This provision shall not apply to any contract by or on behalf of the Company to give to the Directors or any of them an indemnity against any loss which they or any of them may suffer by reason of becoming or being sureties for the Company. A general notice that any Director is a director or a member of any specified Company or is a partner of any specified firm and is to be regarded as interested in any subsequent transactions with such firm or company shall as regards any such transaction be sufficient disclosure under this Article and after such general notice it shall not be necessary to give any special notice relating to any particular transaction with such firm or Company. Any such general notice shall expire at the end of the financial year in which it is given but may be renewed for further period of one financial year at a time, by a fresh notice given in the last month of the financial year in which it will otherwise expire. No such general notice, and no renewal thereof shall be of effect unless either it is given at the meeting of Directors or the Director concerned takes reasonable steps to ensure that it is brought up and read at the first meeting of the Directors after it is given.

111. A Register shall be kept by the Directors in which shall be entered particulars of all contracts or arrangements and which shall be open to inspection by any member of the Company at the office during business hours.
112. The Company shall not make any loan or guarantee any loan made to a Director of the Company or to a firm of which such Director is a partner or to a private Company of which such Director is a member except to the extent permitted by Section 195.
113. The Chairman of the Directors shall be chosen by the Directors from amongst their number at the first Board Meeting following an Election Meeting or at the First Board Meeting following the retirement, resignation, removal or death of the Chairman as the case may be.

PROCEEDINGS OF DIRECTORS

114. Directors may meet together for dispatch of business, adjourn and otherwise regulate their meeting, as they think fit. Questions arising at any meeting shall be decided by a majority of votes and in case of an equality of votes the Chairman of the board shall have a second or casting vote.
115. The quorum of Directors Meeting shall be the minimum as provided in sub Section (1) of Section 193 of the Ordinance.

116. A Director may at any time convene a meeting of the Directors. It shall not be necessary to give notice of a meeting of the Directors to a Director who is for the time being out of Pakistan.
117. Questions arising at any meeting shall be decided by a majority of votes and in case of an equality of votes the Chairman shall have a second or casting vote.
118. A meeting of the Directors for the time being at which a quorum be present shall be competent to exercise all or any of the authorities, powers and discretion by or under these Articles for the time being vested in or exercisable by the Directors generally.
119. In the event of the absence of the Chairman from the place where meetings are normally held he may nominate in writing any other Director to act as Chairman during his absence but such nomination shall be revocable at any time by the Chairman and shall in any case cease to be operative on his return. If at any meeting the Chairman or his nominee is not present the Director present shall choose one of their member to be chairman for that particular meeting.
120. The Directors may from time to time delegate any of their powers to committees consisting of such number of members of their body as they think fit, and may from time to time revoke such delegation. Any committee so formed shall, in the exercise of the powers so delegated conform to any regulations that may from time to time be imposed upon it by the Directors.
121. The meetings and proceedings of any such committee consisting of two or more members shall be governed by the provisions herein contained for regulating the meetings and proceedings of the Directors so far as the same are applicable thereto, and are not superseded by any regulations made by the Directors under the last preceding Article.
122. All acts done by any meeting of the Directors or by a Committee of Directors or by any person acting as a Director shall notwithstanding that it shall afterwards be discovered that there was some defect in the appointment of such Directors or persons acting as aforesaid, or that they or any of them were disqualified be as valid as if every such person had been duly appointed and was qualified to be a Director. Provided that nothing in this Article shall be deemed to give validity to acts done by a Director after the appointment of such Director has been shown to be invalid.
123. A resolution in writing signed by all the Directors for the time being in Pakistan (not being less than the quorum of the meeting of Directors) shall be as valid and effectual as if it has been passed at a meeting of the Directors duly called and constituted.
124. Upon a waiver duly signed by all Directors entitled to notice of meeting, all acts done in a Meeting of Directors shall be valid notwithstanding any irregularity in notice of such Meetings.
125. The Directors shall cause minutes to be duly entered in books provided for the purpose
 - (a) of the name of the Directors present at each meeting of the Directors and of any Committee of Directors;

- (b) of all orders made by Directors and by Committee of Directors; and
- (c) of all resolutions and proceedings of General Meetings and of Meetings of Directors and of committee of Directors. Minutes of the Director's Meeting or of any committee, if purporting to be signed by the Chairman of the next succeeding meeting shall be receivable as prima facie evidence of the matters stated in such minutes.

POWER AND DUTIES OF DIRECTORS

126. The control of the Company shall be vested in the Directors and business of the Company shall be managed by the Directors who in addition to the powers and authorities by these presents or otherwise expressly conferred upon them, may exercise all such powers and do all such acts and things as may be exercised or done by the Company and are not hereby or by statute law expressly directed or required to be exercised or done by the Company in General Meeting but subject nevertheless to the provisions of any statute law and of these present and to any regulations not being inconsistent with these presents from time to time made by the Company in General Meeting; provided that no regulation so made shall invalidate, any prior act of the Directors which would have been valid if such a regulation had not been made.
127. Without prejudice to the general powers conferred by the last preceding Article and to any other powers or authorities conferred by these presents on the Directors, it is hereby expressly declared that the Directors shall have the following powers:
- (1) to pay costs, charges and expenses preliminary and incidental to promotion, formation, establishment and registration of the Company and also to pay promoters all costs and charges they may have incurred in acquiring properties, machinery or other rights which the Company may take over from them;
 - (2) to purchase or otherwise acquire for the Company any property, rights or privileges which the Company is authorized to acquire at such price and generally on such terms and conditions as they think fit, and subject to the provisions of Section 196 to sell, let, exchange or otherwise dispose off absolutely or conditionally any part of the property, privileges and undertaking of the Company upon such terms and conditions, and for such consideration as they may think fit.
 - (3) At their discretion to pay for any property, rights, privileges acquired by or services rendered to the Company either wholly or partially in cash or in shares (subject to Section 86) debentures, or other securities of the Company, and any such shares may be issued as fully paid up and any such bonds, debentures, or other securities, may be either specifically charged upon all or any part of the property of the Company not so charged.
 - (4) To make, draw, endorse, sign, accept, negotiate and give all cheques, bills of lading, drafts, orders, bills of exchange, and other promissory Notes and other negotiable instruments required in the business of the Company.

- (5) To secure the fulfillment of any contracts, agreements or engagements entered into by the Company by mortgage or charge of all or any of the property of the Company or in such other manner as they may think fit.
- (6) To appoint and at their discretion remove or suspend such agents, managers, secretaries, officers clerks and servants for permanent, temporary or special services as they may from time to time think fit, and to determine their powers and duties and fix their salaries or emoluments and to require security in such instances and to such amount as they think fit.
- (7) To appoint any person or persons (whether incorporated or not) to accept and hold in trust for the Company any property belonging to the Company or in which it is interested or for any other purpose, and to execute and do all such deeds, documents and things as may be requisite in relation to any such trust and to provide for the remuneration of such trustee or trustees.
- (8) Subject to the provisions of Section 196 (3) (b) to institute conduct, defend, compound or abandon any legal proceedings by or against the Company or its officers or otherwise concerning the affairs of the Company and also to compound and allow time for payment in satisfaction of any debts due and of any claims or demands by or against the Company.
- (9) To refer any claims or demands by or against the Company to arbitration and observe and perform the awards.
- (10) To make and give receipts, release and other discharges for money payable to the Company and for the claims and demands of the Company.
- (11) To act on behalf of the Company in all matters relating to bankruptcy and insolvency.
- (12) To determine who shall be entitled to sign on the Company's behalf bills, notes, receipts, acceptances, endorsements, cheques, releases, contracts and documents.
- (13) From time to time to provide for the management of the affairs of the Company either in different parts of Pakistan or elsewhere in such manner as they think fit, and in particular to establish branch offices and to appoint any person as the Agent of the Company with such powers (including power to sub delegate) and upon such terms as may be thought fit.
- (14) Subject to the provisions of Section 95A, 96, 195 to invest moneys and 208 to invest and deal with any of the moneys of the Company not immediately required for the purposes thereof upon such securities and in such manner as they may think fit and from time to time to vary or realize such investments.
- (15) Subject to Section 194 to execute in the name and on behalf of the Company in favour of any Director or other person who may incur or be about to incur any personal liability for the benefit of the Company such mortgages of the Company's property (present and future) as they think fit. And any such mortgage may contain a power of sale and such other powers, covenants and provisions as shall be agreed on.

- (16) To give to any person employed by Company a commission on the Profit of any particular business transaction or a share in the general profits of the Company and such commission or shares of Profits shall be treated as part of the working expenses of the Company.
 - (17) From time to time to make, vary and repeal for the regulation of the business of the Company, its officers and servants.
 - (18) To enter into all such negotiations and contracts and rescind and vary all such contracts and execute and do all such acts, deeds and things in the name and on behalf of the Company as they may consider expedient for or in relation to any of the matters, aforesaid or otherwise for the purposes of the Company.
 - (19) To establish, maintain, support and subscribed to any charitable or public object, and any institution, society, or club which may be for the benefit of the Company or its employees or may be connected with any town or place where the Company carries on business; to give pensions, gratuities or charitable aid to any person or persons who have served the Company or to the wives, children or dependents of such person or persons, that may appear to the Directors just or proper, whether such person, his widow, children or dependents have or have not a legal claim upon the Company.
 - (20) Subject to the provisions of Sections 227 and 235, before recommending any dividends to Company to form a Fund to provide for such pensions, gratuities, or compensation or to create any Provident or Benefit Fund in such or any other manner, as the Directors may seem fit.
 - (21) To make and alter rules and regulations concerning the time and manner of payment of the contributions of the employees and the Company respectively to any such Fund and the accrual, employment, suspension and forfeiture of the benefits of the said Fund and the application and disposal thereof, and otherwise in relation to the working and management of the said funds as the Directors shall from the time to time think fit subject to the provision of Section 227.
 - (22) Subject to the provisions of the Ordinance, to delegate all or any of the powers hereby conferred upon them to such persons, as they may from time to time think fit subject to the provisions of the Ordinance.
128. Directors may from time to time by powers of attorney under seal appoint any Company, firm or person, or any fluctuating body of persons, whether nominated directly or indirectly by Directors to be 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 presents) and for such period and any such power of attorney may contain such provisions for protection and convenience of persons dealing with any such attorney as the Directors may think fit and may also authorize any such attorney to sub delegate all or any powers, authorities and discretion vested in him.

CHIEF EXECUTIVE

129. The Directors shall appoint any individual to be the Chief Executive of the Company as provided in Sections 198 and 199 of the Ordinance.
130. No person who is ineligible to become Director of the Company shall be appointed or continue as the Chief Executive except as permitted by Section 187.
131. The Chief Executive shall be deemed to be Director and be entitled to all the rights and privileges, and subject to all the liabilities of that office.
132. Within fourteen days from the day of election of Directors or the office of the Chief Executive falling vacant, as the case may be the Directors shall appoint any person, including an elected Director to be the Chief Executive, but such appointment shall not be for a period exceeding three years from the date of appointment.
133. On the expiry of his term of office under Articles 132 the Chief Executive shall be eligible for re appointment.
134. The Chief Executive retiring under Articles 132 shall continue to perform his functions until his successor is appointed unless nonappointment of his successor is due to any fault on his part or his office is expressly terminated.
135. The Directors of the Company by resolution passed by not less than three fourths of the total number of Directors for the time being, or the Company by a special resolution, may remove a Chief Executive before the expiration of his term of office notwithstanding anything contained in these articles or in any agreement, between the Company and such Chief Executive.
136. The Chief Executive shall receive such remuneration (whether by way of salary, commission, participation in profits, allowances, perquisites, etc., or partly in one way and partly in another) as the Board may fix.

ALTERNATE DIRECTORS

137. A Director may, with the approval of the Directors, appoint an Alternate Director to act for him during his absence from Pakistan for not less than three months and such appointment shall have the effect and such appointee while he holds office of Alternate Director shall be entitled to notice of Meetings of the Directors and to attend and vote there at accordingly. The alternate director shall ipso facto vacate office as and when the Director appointing him returns to Pakistan or removes appointee from office. Any appointment and removal under the Article should be effective by notice in writing under the hand of the Director making the same.
138. An Alternate Director shall, in the absence of a direction to the contrary in the instrument appointing him, be entitled to receive notice of and to vote at general Meeting of the Company on behalf of his appointor and generally to represent his appointor in the same manner as if he had been appointed a General proxy under the provisions of this Article.

SECRETARY

139. A Secretary when appointed by Directors to perform secretarial and other administrative functions at such remuneration and upon such terms and conditions, as they may think fit, and any Secretary, so appointed may be removed by them. The Secretary shall be responsible to ensure compliance with the provision of the Ordinance relating to filing of returns, information etc.

THE SEAL

140. Directors shall provide a common seal for purposes of the Company and shall have power from time to time to destroy the same and substitute a new Seal in lieu thereof and they shall provide for safe custody of the Seal.
141. The Company may exercise the powers conferred by Section 213 and such powers shall accordingly be vested in the Directors.

ANNUAL RETURNS

142. The company shall make requisite annual Returns in accordance with Section 156 of the Ordinance.

DIVIDENDS

143. The Directors shall have powers to make such appropriation out of the distributable profit and to determine the amount to be paid as dividend as they may think expedient.
144. The Company in General Meeting may declare a dividend to be paid to the members according to their rights and interest in the profits.
145. No larger dividend shall be declared than is recommended by the Directors, but the Company in General Meeting may declare a smaller dividend.
146. No dividend shall be payable except out of the profits of the Company of the year or any other undistributed profits or in contravention of Section 235 & 248.
147. The Directors may from time to time pay to the members such interim dividends as in their judgement the position of the Company justifies.
148. Subject to the rights of the persons, if any, entitled to shares profit with any special rights, the dividend shall be paid in proportion to the amount paid on the share.
149. Any General Meeting may resolve that any moneys, investments, or other assets forming part of the undivided profits of the Company standing to the credit of any Reserve or other Fund or in the hands of the Company and available for dividend (or representing premiums received on the issue of shares and standing to the credit of the share premium

account) be as would be entitled to receive the same if distributed by way of dividend and in the same proportion on the footing that they become entitled thereto as capital and that all or any part of such capitalised fund be applied on behalf of such shareholders in paying up in full any unissued shares debentures or debenture stock of the Company which shall be distributed accordingly and that such distribution of payment shall be accepted by such shareholders in full satisfaction of their interest in the said capitalised sum.

150. A General Meeting may resolve that any surplus moneys arising from the realization of any capital assets of the Company or any investments representing the same, or any other undistributed profits of the Company not subject to charge for income tax, be distributed among the members on the footing that they receive the same as capital and that all or any part thereof be applied on behalf of such shareholders in paying up in full either at par or at such premium as the resolution may provide, any unissued shares or debentures or debenture stock of the Company which shall be distributed accordingly and that such distribution or payment shall be accepted by such shareholders in full satisfaction of their interest in the said moneys, investments or profits so distributed subject to the provisions of Sections 235 and 248.
151. For the purpose of giving effect to any resolution under the three last preceding Articles the Directors may settle any difficulty which may arise in regard to the distributions as they think expedient and may fix the value for distribution of any specific assets, and may determine that cash payments shall be made to any members upon the footing of the value so fixed in order to adjust the rights of all parties and may vest any such cash or specific assets in trustees upon such trusts for the persons entitled to the dividend or capitalised fund as may seem expedient to the Directors. Where requisite a proper contract shall be filled in accordance with Section 73 and the Directors may appoint any person to sign such contract on behalf of the persons entitled to the dividend or capitalised fund, and such appointment shall be effective.
152. A transfer of shares shall not pass the rights to any dividend declared thereon before the registration of the transfer.
153. The Directors may retain the dividends payable upon shares in respect of which any person is under the transmission Article entitled to become a member or which any person under that Article is entitled to transfer until such person shall become a member in respect thereof or shall duly transfer the same.
154. Any one of several persons who are registered as the joint holders of any share may give effectual receipts for all dividends and payments on account of dividends in respect of such share.
155. Unless otherwise directed any dividend may be paid by cheque or warrant sent through the registered post to the registered address of the member or person entitled thereto, or in the case of joint holders to the registered address of that one whose name stands first on the register in respect of the joint holding or to such person and such address as the member or person entitled or such joint holders as the case may be, may direct, or to his or their banker or to a financial institution nominated by him or them for the purpose.

156. All dividends unclaimed for one year after having been declared may be invested or otherwise made use of by the Directors for the benefit of the Company until claimed. No dividend shall be forfeited by the Company.
157. The dividend declared by the Company shall be paid within the period provided in Section 251 of the Ordinance.
158. No dividend shall bear interest against Company.
159. The divisible profit of the Company shall be determined after charging all the expenses of working and management, depreciation on fixed assets and investments, interest and markup on loans and after making such adjustments as are necessary under the Ordinance or the generally accepted accounting principles, international accounting standards, guidelines of the institute of chartered accountants of Pakistan, etc.

BOOKS OF ACCOUNT

160. The Directors shall cause to be kept proper books of account with respect to:
- (a) all sums of money received and expended by the Company and the matters in respect of which the receipt and expenditure takes place;
 - (b) all sales and purchases of goods by the Company;
 - (c) the assets and liabilities of the Company;
 - (d) any other matter required by Section 230.
161. The books of account shall be kept at the Registered Office or at such other place, as the Directors think fit.
162. The Directors shall from time to time determine whether and to what extent and at what times and places and under what conditions or regulations the accounts and books of the Company or any of them shall be open to the inspection of the members not being Directors, and no member (not being a Director) shall have any right of inspecting any account or book or document of the Company except as conferred by law or authorized by the Directors or by the Company in General Meeting.

FINANCIAL STATEMENTS AND REPORTS

163. The Directors shall at least in each calendar year lay before the Company in Annual General Meeting, the financial Statements made upto a date not later than the date of meeting by more than four months.
164. The financial statements shall be prepared in accordance with the provisions of Sections 234, 235 and 237 or the other provisions as contained in the Ordinance or amended from time to time.

165. The Directors shall make out and attach to every financial statements a report with respect to the state of Company's affairs, the amount, if any, which they recommend should be paid by way of a dividend and the amount, if any which they propose to carry to the Reserve Fund, General Reserve, pattern of share holding and such other matters which are specified in Section 236.
166. Financial statements shall be signed by the Chief Executive and at least one Director or if the Chief Executive is not for the time being in Pakistan by two Directors. Whenever any such Financial Statement is not signed by the Chief Executive only then, there shall be subjoined thereto a statement signed by such Directors explaining the reason why it has not been signed by the Chief Executive.
167. A copy of such financial statement duly audited, together with the Reports of the Auditors and Directors shall at least twenty one days prior to the meeting be sent to every registered holder of shares of the Company and to such other persons as are entitled to receive notice of General Meetings in a manner in which notices are to be given as provided hereunder, and a copy shall also be deposited at the office for the inspection of members of the Company During a period of at least twenty one days before the meeting.
168. Directors shall in all respects comply with provisions of Sections 233, 234, 236, 237, 241, 242, 243 and 245 or any statutory modifications thereof for the time being in force.
169. The Company shall appoint an auditor to audit the financial statements of the Company. The appointment, qualification, disqualification, filling of casual vacancy, remuneration, renewal, powers and duties of auditors shall be governed by the provisions of Section 252 to 255.
170. The Auditors shall make a report to the members of the Company on the financial statements which are laid before the Company in General Meeting during his tenure of office and the report shall state the matters specified in Section 255.

NOTICES

171. A notice may be given by the Company to any member either personally or by sending it by post to him to his registered address or if he has no registered address in Pakistan to the address, if any, within Pakistan supplied by him to the Company for the giving of notices to him.
172. Where a notice is sent by post, service of the notice shall be deemed to be effected by properly addressing, prepaying and posting 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.
173. If a member has no registered address in Pakistan and has not supplied to the Company an address within Pakistan for the giving of notices to him, a notice addressed to him or to the shareholders generally and advertised in a newspapers circulating in neighborhood of the Registered office shall be deemed to be duly given to him on the day on which the advertisement appears.

174. A notice may be given by the Company to the joint holder named first in the register in respect of the share.
175. 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 by sending it through the post in a prepaid letter addressed to them by name, or by the title of 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.
176. Notice of every General Meeting shall be given in the same manner as herein before authorized to (a) every member of the Company (except those members who having no registered address within Pakistan have not supplied to the Company and address within Pakistan for the giving of notices to them), (b) every person entitled to a share in consequence of the death or insolvency of a member, (c) the Auditors of the Company.
177. Any notice required to be given by the Company to the members or any of them and not expressly provided for by these presents shall be sufficiently given if given by advertisement.
178. Any notice given by advertisement shall be deemed to have been given on the day on which the advertisement shall first appear.
179. Every person who by operation of law, transfer or other means whatsoever shall become entitled to any share shall be bound by every notice in respect of such share which previously to his name and address being entered on the register shall be duly given to the person from whom he derives his title to such share.
180. Any notice or document delivered or sent by post to or left at the registered address of any member in pursuance of these presents shall, notwithstanding such member be then deceased and whether or not the Company have notice of his death, be deemed to have been duly served in respect of any registered shares whether held solely or jointly with the persons by such member, until some other person registered in his stead as the holder or joint holder thereof and such service shall for all purposes of these presents be deemed a sufficient service of such notice or documents on his or her heirs, executors or administrators, and all persons, if any jointly interested with him or her in any such share.
181. The signature to any notice to be given by the Company may be written or printed.
182. Notice of any resolution for winding up a Company voluntarily shall be given by the Company within ten days of the passing of the same by advertisement in the official Gazette and also in a newspaper circulating in the Province where the registered office of the Company is situated.

RECONSTRUCTION

183. On any sale of the undertaking of the Company, the Directors or the Liquidators on a winding up may, if authorized by a Special Resolution, accept shares, debentures or securities of any other Company, whether incorporated in Pakistan or not either then

existing or to be formed for the purchase in whole or in part of the property of the Company, and the Directors (if the profits of the Company permit), or the Liquidators (in a winding up) may distribute such shares, or securities or any other property of the Company amongst the members without realization, or vest the same in trustees for them and any Special Resolution may provide for the distribution or appropriation of the cash, shares or other securities, benefits or property, otherwise than in accordance with the strict legal rights of the members or contributors of the Company, and for the valuation of any such securities or property at such price and in such manner as the meeting may approve, and all holders of shares shall be bound to accept and shall be bound by any valuation or distribution so authorized, and waive all rights in relation thereto, save only in case the Company is proposed to be or is in the course of being wound up, such statutory rights (if any) under any provisions of the Ordinance as are incapable of being varied or excluded by these presents.

SECRECY

184. Every Chief Executive, Director, Auditor, trustee, member of a committee, officer, servant, agent, accountant, or other person employed in the business of the Company shall, if so required by the Directors before entering upon his duties, sign a declaration pledging himself to observe a strict secrecy respecting all transactions of the Company with its customers and the state of accounts with individuals and in matters relating thereto, and shall by such declaration pledge himself ~~not to reveal~~ any of matters which may come to his knowledge in the discharge of his duties except when required so to do by the Directors or by any meeting or by a court of law and except so far as may be necessary in order to comply with any of the provisions in these presents contained or of the Ordinance.
185. No member or other person ~~not being~~ a Director) shall be entitled to enter the property of the Company or inspect or examine the Company's premises or properties of the Company without the permission of the Directors of the Company for the time being or subject to Article 167 to require discovery of or any information respecting any detail of the Company's trading or any matter which is or may be in the nature of a trade secret, mystery of trade or secret process or of 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 inexpedient in the interest of the members of the Company to communicate.

WINDING UP

186. Without prejudice to the rights of the holders of shares and subject to special terms and conditions if any on the winding up and Section 385 the assets available for distribution among the members as such be insufficient to repay the whole of the paid up capital, such assets shall be distributed so that as nearly as may be, the losses shall be borne by the members concerned in proportion to the capital paid up or which ought to have been paid up at the commencement of the winding up, on the shares held by them respectively, and if in a winding up assets available for distribution among the members shall be more than sufficient to repay the whole of the capital paid up to the members in proportion to the shares held by them respectively at the commencement of the winding up.
187. If the Company shall be wound up, whether voluntarily or otherwise the liquidators may with the sanction of a Special Resolution divide amongst the contributories in specie or kind any part of the assets of the Company and may with the like sanction vest any part of the assets of the Company in trustees upon such trusts for the benefit of the contributories or any of them as the Liquidators, shall think fit.

188. If thought expedient the division of assets on winding up may be made otherwise than in accordance with legal rights of the contributories (except where unalterable fixed by the Memorandum of Association) and in particular any class may be given preferential or special rights or may be excluded altogether or in part, but in case any division otherwise than in accordance with legal rights of the contributories shall be determined on any contributory who would be prejudiced thereby shall have a right to dissent and ancillary rights as if such determination were a Special Resolution passed pursuant to Section 367.




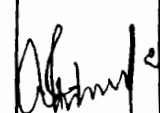
ARBITRATION

189. Whenever any difference arises, between the Company on the one hand and any of the members, their executors, administrators or assignees on the other hand, touching the true intent or construction of the incidents or the consequences of these presents or of the statutes or touching anything done or hereafter to be done, executed, omitted or suffered in pursuance of these presents 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 to decision of an arbitrator to be appointed by the parties in difference, or if they cannot agree upon a sole arbitrator, to the decision of two arbitrators, of whom one shall be appointed by each of the parties in difference, or an umpire to be appointed by the two arbitrators.
190. Cost of and incident, to any such reference and award shall be at the discretion of arbitrator or arbitrators or umpire as the case may be, who may determine the amount thereof and may award by whom and in what manner the same shall be borne and paid.
191. Subject to provisions of Section 194 every Chief Executive, Director, Auditor and other officer or servant of the Company acting in relation to the Company and every one of them and every one of their heirs executors and administrators shall 'be indemnified by the Company against, and it shall be the duty of Directors out of funds of the Company to pay, all costs, losses and expenses, which any such officer or servant may incur or become liable to by reasons of any contract entered into, or act or thing done by him as such officer or servant or in any way in discharge of his duties including travelling expenses and in particular, and so as not to limit the generality of the foregoing provisions, against all liabilities incurred by him as such Director, Manager, Officer or servant in defending any proceedings whether civil or criminal in which judgement is given in his favour or he is acquitted, or in connection with any application under Section 488 in which relief is granted by the court and the amount for which such indemnity is provided shall immediately attach as a lien on property of the Company and have priority as between the members over all other claims.

DISPUTE RESOLUTION

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

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

Names & Surname (Present & Former) on Block Letters	Father's / Husband Name in full	Nationality *with any Former Nationality	Occupation	Residential Address in full	Number of shares taken by each subscriber	Signature
Habib Sugar Mills Limited Through: Mr. Asghar D. Habib 42201-5320795-5	Incorporation No. CUIN - 02673 (Late) Dawood Habib	Pakistani	-	3 rd Floor, Imperial Court, Dr. Ziauddin Ahmed Road, Karachi	8,500 (eight thousand five hundred only)	
Mr. Asghar D. Habib 42201-5320795-5 (Nominee of Habib Sugar Mills Limited)	(Late) Dawood Habib	Pakistani	Business/ Industrialist Karachi	ST-25/D, KDA Scheme No. A-1 Karachi	500 (five hundred only)	
Mr. Murtaza Habib 42000-3013439-3 (Nominee of Habib Sugar Mills Limited)	(Late) Hussain D. Habib	Pakistani	Business/ Industrialist Karachi	A/36/B, KDA Scheme No. 1 Karachi.	500 (five hundred only)	
Mr. Amin Ali 42301-1079410-5 (Nominee of Habib Sugar Mills Limited)	Mr. Abdul Hamid	Pakistani	Business/ Industrialist Karachi	278-D, Block A, KDA Scheme No. 1-A Karachi	500 (five hundred only)	
Total					10,000 (Ten thousand only)	

Dated 12th day of May 2017

Certified to be True Copy
23/5/17
Deputy Registrar of Companies

Witness to the above Signatures

Syed Ali Niaz Akhtar Naqvi
S/O. (Late) Syed Hasan Akhtar
Private Service
4th Floor, Imperial Court,
Dr. Ziauddin Ahmed Road
Karachi.

Technology, Type and Model of the Facilities

Plant Type and Technology

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 HSML. During the crushing season, HSML needs steam and electricity to crush the sugar cane and produce sugar. Steam for HSML will be supplied from the controlled extraction of the steam turbine which is at approximately 2.5 bar(a) pressure.

Combustion technology based on the Rankine Cycle will be utilized in this project which is proven to be the 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 HSMEL, 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 HSMEL proposes 1x135 TPH capacity boilers and 1x26.5 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.



Design and Specifications of the Plant

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; 135 TPH
- Steam pressure at the Main Steam stop valve outlet: 110 bar(a)
- Steam temperature at the Main steam stop valve outlet at MCR: $540 \pm 5^{\circ}\text{C}$
- Boiler feed water temperature at the inlet to the Deaerator: 210°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: 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 the 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 Preheater. 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 Preheater. 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 [400V] drive motors with 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.

Steam Turbine and Auxiliaries

Steam Turbine

The turbine of the cogeneration power plant will be multistage nozzle governed, horizontal spindle, two bearings, and extraction cum condensing type with 2 numbers of uncontrolled extractions and 1 number of control extractions. The exhaust from the turbine will be condensed in the surface condenser at 0.97 bar (a) pressure during off-season operation.

The low-pressure steam at 3 bar (a), 33.5°C will be supplied to the sugar plant for juice heating in the evaporator station. The medium pressure steam at 5 bar (a), 55°C will be supplied for centrifugal washing. 95% condensate of the supplied LP steam will be returned from the sugar mill. There will be no condensate return of medium pressure steam.

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.

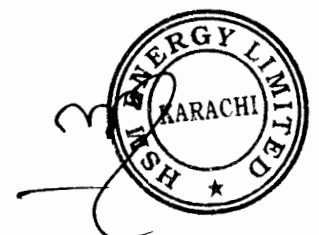
Couplings

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

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 (CEPs), 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

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 electrical output rating shall be as follow:

- 33.125 MVA rated capacity at 50⁰C ambient.
- 11 ± 10% KV
- 50 ± 5% Hz
- 3 Phase
- Power factor (0.8 lag to 0.95 lead)
- ± 0.5% Accuracy Control

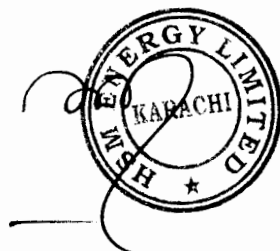
Generator Protection and Control System:

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

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

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

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)

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:

Main Cooling Water Pumps

Three (3) Main Cooling Water Pumps (two working and one standby) each of capacity approximately 3000 m³/hr shall be provided. Pumps will be horizontal centrifugal type, driven by electric motors.

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.

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 6000 m³/hr and is combined and common for the whole cogeneration power plant.
- There shall be 6 cells each having a capacity of approximately 1000 m³/hr.
- The cooling tower will be designed for a cooling range of 10 °C, and an approach of 2°C while operating under the atmospheric wet bulb temperature of about 28°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 42°C and 32°C respectively.

Raw Water System

Raw water system consists off the following components:

Cooling Water Makeup Pump

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

Raw Water Transfer Pumps

Two (2) Raw Water Transfer Pumps (one working and one standby) each of capacity 50 m³/hr will be provided to ensure raw water supply to Water Treatment Plant.

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.

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.



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.

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.

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.

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 30 m³/hr. DM water is collected in two DM water tanks each having a capacity of 500 m³. Water will be distributed from DM tanks through pumps to different users i.e. Deaerator, Condenser etc.

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:



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.

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.

Portable Fire Extinguishers:

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

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.

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 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.

Effluent Handling System

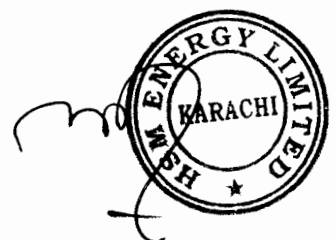
Effluent handling system consists of the following main components:

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.

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.

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.

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 15 m³/hr.

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.

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 25 Tons and suitable for lifting single heaviest component in Turbo Generator. The auxiliary hook lifting capacity shall be of 5 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.

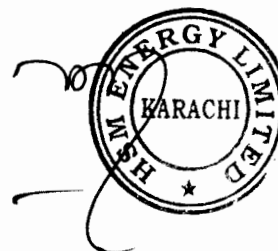
The single hook crane capacity shall be 10 Tons. The crane travel will cover the entire length of maintenance bay of workshop. Operation of crane shall be by pendant type push button station from ground level.

Electrical Design

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 a 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 transformers (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 transformer.

Ambient Conditions for Electrical Equipment

Ambient conditions and design temperatures for electrical equipment are given in Table 6 below:

Table 6: Ambient Conditions for Electrical Equipment

	Deg °C
Maximum Temperature	55
Minimum Temperature	5
Plant Design Temperature	50
Indoor Equipment Design	50
Outdoor Equipment Design	50

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 7 below:

Table 7: Plant Operating Voltage

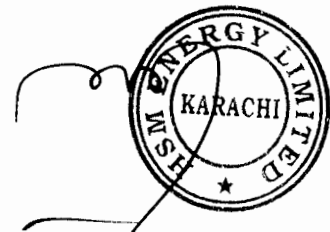
Generation (TG) system	11 kV
Power evacuation system	132 kV
Non-AC VSD / auxiliaries of cogeneration plant	110 V
AC VSD / auxiliaries of co-generation plant	400 V
DC system of co-generation plant	24 V
UPS system of co-generation plant	220 V

Basic Electrical Design Parameters

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

Table 8: Basic Electrical Design Parameters

Power Factor (lagging)	0.8
Generation Voltage (kV)	11 kV, 3 phase



Parallel operation with Grid	Required with 132 kV 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	40 kA
11 kV	40 kA
400 V	50 kA
Fault Level & Withstand Duration	
132kV Switchgear	40 kA for 1 sec
For 11 kV Switchgear	40 kA for 3 sec
For 400 V Switchgear	50 kA for 1 sec
400V Lighting System	10 kA for 1 sec
11kV Isolated Phase Bus Ducts	40 kA for 3 sec
110VDC	25 kA for 1 sec
48VDC	10 kA for 1 sec
230VAC	10 kA for 1 sec
Transformer and all accessories	All transformers and its accessories shall be capable of withstanding for 3 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

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 9: 132kV Switchyard Specifications

Voltage Level	132 kV
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	3150 Amp 40 kA 1 sec
Isolator (Centre break, motor operated with copper alloy blades)	2000 Amp
Protection & Metering	As per NTDC Requirements
Highest System Voltage(kV rms)	145 kV



Power frequency withstand capability (kV rms)	275 kV
Basic insulation level (kV peak)	650 kV
Creepage distance for insulators (mm/kV)	25
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

Steam Generator

Generator shall be supplied in line with the following specifications:

Table 10: Steam Generator Specifications

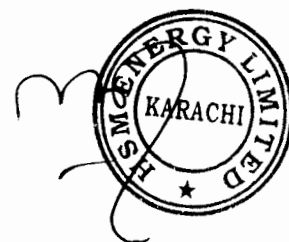
Description	Parameters
Rating & Count	26 MW
Type	Synchronous type
Number of pole & Excitation System	Four pole, with brushless excitation system.
Power Factor	0.8 PF (lagging) to 0.95 (leading) under entire band of +10% voltage variation and +5% frequency variation
Insulation Class	Class 'F' insulation 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

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 thickness 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
--------------	---

11kV Switchboard

Switchboard rated 11kV IP4X 3200Amp 50kA for 3 sec shall be provided for feeding transformers and connection to steam generator.

6.6kV Panel

One (1) 2500A 6.6kV VCB stand-alone panels and HT 6.6kV XLPE Aluminum cables of adequate size shall be provided for interface of co-gen plant with existing sugar mill power house.

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 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.

The co-generation plant non-AC VSD loads shall be fed at 400V with two (2) 11/0.415kV transformers.

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	Min. [28/35] MVA [132/11] kV YNd1
VSD transformers [Three winding transformer] for co-generation plant	3.15 MVA 11/0.415/0.415 kV, Dyn11Dzn0
Distribution transformer for cogeneration Plant auxiliaries	1.6MVA, 11/0.415kV, Dyn11
Interconnection transformer at sugar Plant	10/13MVA, 11/6.9kV, Dyn11
Lighting Transformer	Zn0 windings, 50A for 10Sec & 500A for 3Sec, 11KV, ONAN
Neutral Grounding Transformer	Min. [28/35] MVA [132/11] kV YNd1

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]

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.

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.

RTDs & Thermistors

Thermistors shall be installed on motors rated between 50 to 1000 kW. RTD shall be made available for motors more than 500 kW. All RTDs shall be hooked up with relays in Motor Relays in respective MCC.

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 50 kA to suit the system requirement, through the 11 kV neutral point of TG. The 11 kV 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 11 kV system at the secondary side of Interconnection Transformer shall be provided with NGR grounding to limit earth fault current of 50A.

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

400V VSD transformer grounding system shall be as for 6 Pulse AC VSD drives – Solidly grounded.

400V 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.

Cable Installation

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

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.

Lighting & Small Power

Plant lighting loads shall be fed through two (2) Nos. of 400/400V, Dyn11 connected dry type lighting transformer of minimum rating of 200 kVA.

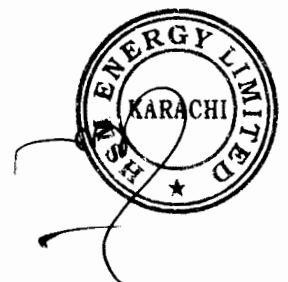
Emergency Lighting Distribution Board ("ELDB") shall be fed through inverter of minimum 20 kVA rating.

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.

Plant Communication System

Plant communication shall be provided with following facility:



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

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)

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.

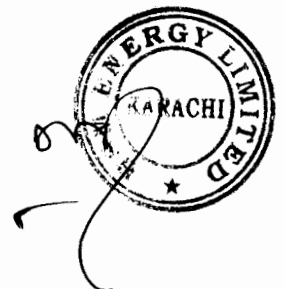
Plant startup can also be managed either from Grid supply or existing plant sugar mill feeder. In either case power shall be available at the main 11kV MV Panel. Through respective step down distribution transformers power shall be fed to desired STG auxiliaries and common co-generation plant loads.

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

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 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

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 a separate room with the window to the 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.

Field Instrumentation

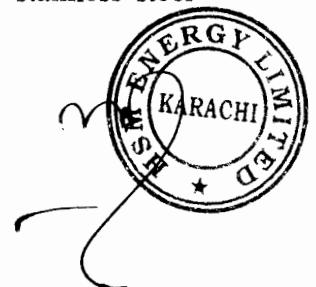
Instrument power circuits will employ an isolation transformer and will be individually protected from fault with the help of MCB's and fuses. Power supply to the individual instrument will be disconnect-able with the help of switch and will be protected with the help of fuse.

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.

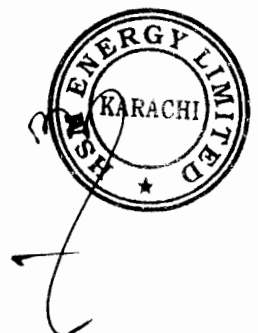
The operating value of field instrument will fall between 40% and 60% span for linear and 60% to 80% span for square root.

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 to permit safe maintenance, removal, testing and calibration of instruments during plant operation.



HSM Energy Limited

26.5 MW Bagasse-based Cogeneration Power Project
Nawabshah, District Shaheed Benazirabad, Sindh

Feasibility Report



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1 Project Background

Habib Sugar Mills Limited (“HSML”), through a wholly-owned subsidiary HSM Energy Limited (“HSMEL”), intends to set up a green field 26.50 MW (Gross) high-pressure, bagasse based co-generation power plant (the “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 HSML located at Nawabshah, District Shaheed Benazirabad, 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 as partially meet the steam and power requirements of HSML during the crushing season. The Project will enable HSML to establish a sustainable market for its by-product, bagasse, and will also allow the sponsors of HSML 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 financial feasibility report (“Feasibility”) is to assist HSML in assessing the viability of the Project under a *given set of assumptions*.

2 Power Market

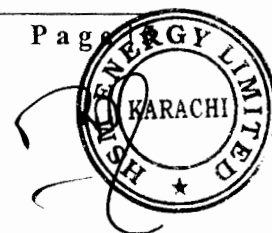
2.1 Structure of Power Sector in Pakistan

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 several 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 by 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

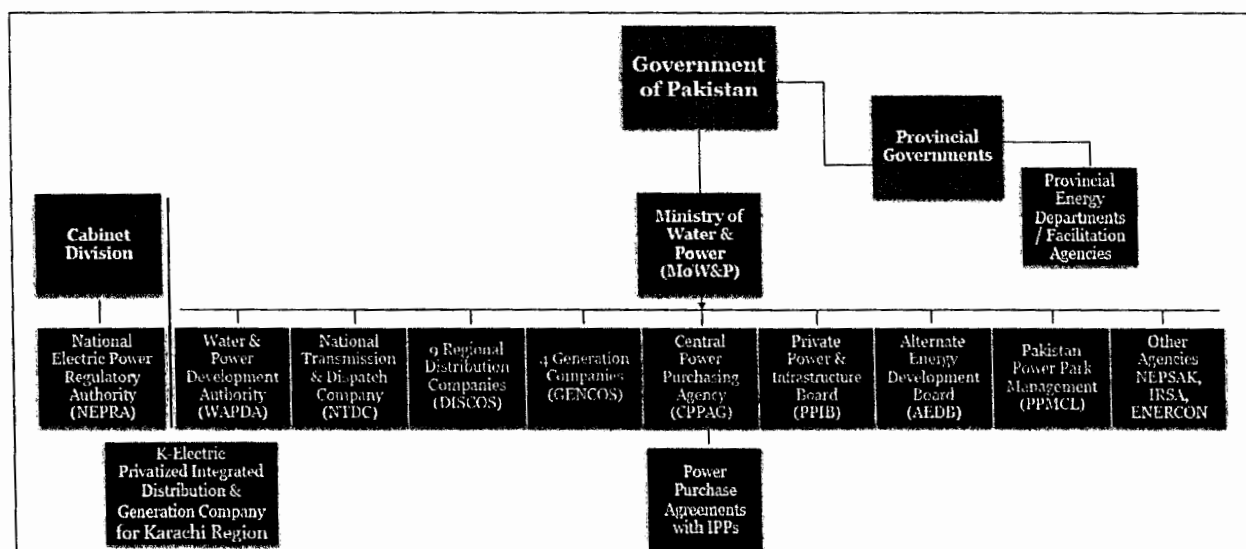
As on 30 th June	2011	2012	2013	2014	2015
Thermal	15,910	15,969	15,941	15,719	16,814
Hydropower	6,645	6,730	6,947	7,116	7,116
Nuclear	787	787	787	787	787
Wind	0	1	50	106	106
Total	23,342	23,487	23,725	23,728	24,823

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

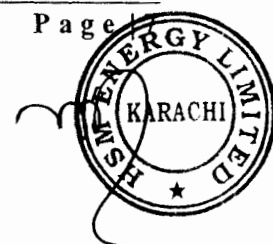


Table 5: Pakistan Projected Supply and Demand of Power

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 per 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 HSML/HSMEL 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.

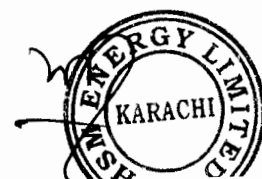
5 The Project

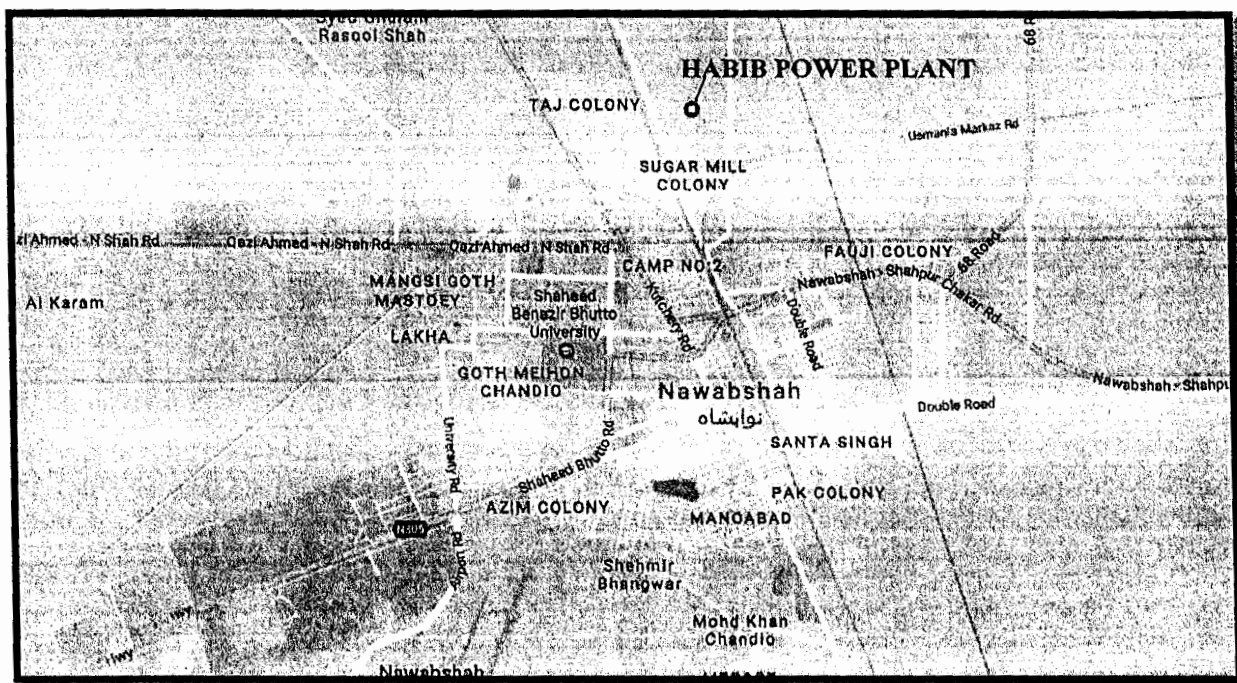
The 26.50 MW Co-generation Project envisages a 1+1 configuration power plant comprising of a high pressure (110 bar) traveling grate boiler having a steam capacity 135 tons per hour, a 26.50 MW condensing/extraction steam turbine generators and balance of plant ("**Plant**"). It is planned that, **during the crushing period**, steam and power for HSML operations will be provided from the existing Low Pressure ("**LP**") system and the balance steam/power requirement of HSML will be met through the High Pressure ("**HP**") system of the Plant. During the crushing period, bagasse from HSML 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 HSML / purchase from other parties as fuel. Detailed workings regarding the fuel availability and generation mix are provided in the following sections.

5.1 Project Site and Location

The Project will be located adjacent to HSML located at Nawabshah, District Shaheed Benazirabad, Sindh, Pakistan. Approximately 20.6 acres will be allocated to the construction of the power plant.

A map of the Project site is given below and a detailed plant 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 HSML. During the crushing season, HSML needs steam and electricity to crush the sugar cane and produce sugar. Steam for HSML will be supplied from the controlled extraction of the steam turbine which is at approximately 2.5 bar(a) pressure.

Combustion technology based on the Rankine Cycle will be utilized in this project which is proven to be the 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 HSMEL, 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 HSMEL proposes 1x135 TPH capacity boilers and 1x26.5 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; 135 TPH
- Steam pressure at the Main Steam stop valve outlet: 110 bar(a)
- Steam temperature at the Main steam stop valve outlet at MCR: $540 \pm 5^{\circ}\text{C}$
- Boiler feed water temperature at the inlet to the Deareator: 210°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: 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 the 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 Preheater. 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 Preheater. 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 [400V] drive motors with 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

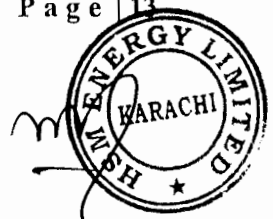
7.2.1 Steam Turbine

The turbine of the cogeneration power plant will be multistage nozzle governed, horizontal spindle, two bearings, and extraction cum condensing type with 2 numbers of uncontrolled extractions and 1 number of control extractions. The exhaust from the turbine will be condensed in the surface condenser at 0.97 bar (a) pressure during off-season operation.

The low-pressure steam at 3 bar (a), 33.5°C will be supplied to the sugar plant for juice heating in the evaporator station. The medium pressure steam at 5 bar (a), 55°C will be supplied for centrifugal washing. 95% 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 (CEPs), 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 electrical output rating shall be as follow:

- 33.125 MVA rated capacity at 50⁰C ambient.
- 11 ± 10% KV
- 50 ± 5% Hz



- 3 Phase
- Power factor (0.8 lag to 0.95 lead)
- $\pm 0.5\%$ Accuracy Control

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 3000 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 6000 m³/hr and is combined and common for the whole cogeneration power plant.
- There shall be 6 cells each having a capacity of approximately 1000 m³/hr.
- The cooling tower will be designed for a cooling range of 10 °C, and an approach of 2°C while operating under the atmospheric wet bulb temperature of about 28°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 42°C and 32°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 50 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 30 m³/hr. DM water is collected in two DM water tanks each having a capacity of 500 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 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 15 m³/hr.

7.15 Service Water System

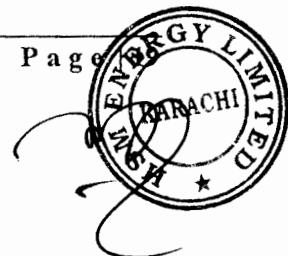
Two (2) service water pumps (One working and one standby) will be installed to provide service water to plant users. One (1) expansion vessel will be installed to keep service water header pressurized.

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 25 Tons and suitable for lifting single heaviest component in Turbo Generator. The auxiliary hook lifting capacity shall be of 5 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 10 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 a 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 transformers (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.

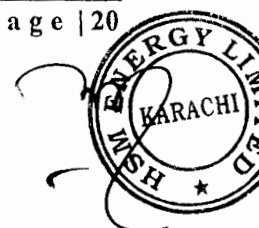
All the existing sugar plant loads shall be fed through one (1) interconnecting transformer.

8.1.1 Ambient Conditions for Electrical Equipment

Ambient conditions and design temperatures for electrical equipment are given in Table 6 below:

Table 6: Ambient Conditions for Electrical Equipment

	Deg °C
Maximum Temperature	55
Minimum Temperature	5



Plant Design Temperature	50
Indoor Equipment Design	50
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 7 below:

Table 7: Plant Operating Voltage

Generation (TG) system	11 kV
Power evacuation system	132 kV
Non-AC VSD / auxiliaries of cogeneration plant	110 V
AC VSD / auxiliaries of co-generation plant	400 V
DC system of co-generation plant	24 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 8: Basic Electrical Design Parameters

Power Factor (lagging)	0.8
Generation Voltage (kV)	11 kV, 3 phase
Parallel operation with Grid	Required with 132 kV 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	40 kA
11 kV	40 kA
400 V	50 kA
Fault Level & Withstand Duration	
132kV Switchgear	40 kA for 1 sec
For 11 kV Switchgear	40 kA for 3 sec
For 400 V Switchgear	50 kA for 1 sec
400V Lighting System	10 kA for 1 sec
11kV Isolated Phase Bus Ducts	40 kA for 3 sec
110VDC	25 kA for 1 sec
48VDC	10 kA for 1 sec
230VAC	10 kA for 1 sec



Transformer and all accessories	All transformers and its accessories shall be capable of withstanding for 3 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 9: 132kV Switchyard Specifications

Voltage Level	132 kV
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	3150 Amp 40 kA 1 sec
Isolator (Centre break, motor operated with copper alloy blades)	2000 Amp
Protection & Metering	As per NTDC Requirements
Highest System Voltage(kV rms)	145 kV
Power frequency withstand capability (kV rms)	275 kV
Basic insulation level (kV peak)	650 kV
Creepage distance for insulators (mm/kV)	25
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

8.5 Steam Generator

Generator shall be supplied in line with the following specifications:

Table 10: Steam Generator Specifications



Description	Parameters
Rating & Count	26 MW
Type	Synchronous type
Number of pole & Excitation System	Four pole, with brushless excitation system.
Power Factor	0.8 PF (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

8.6 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 thickness 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

8.7 11kV Switchboard

Switchboard rated 11kV IP4X 3200Amp 50kA for 3 sec shall be provided for feeding transformers and connection to steam generator.

8.8 6.6kV Panel

One (1) 2500A 6.6kV VCB stand-alone panels and HT 6.6kV XLPE Aluminum cables of adequate size shall be provided for interface of co-gen plant with existing sugar mill power house.

8.9 400 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 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.

The co-generation plant non-AC VSD loads shall be fed at 400V with two (2) 11/0.415kV transformers.

8.10 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	Min. [28/35] MVA [132/11] kV YNd1
VSD transformers [Three winding transformer] for co-generation plant	3.15 MVA 11/0.415/0.415 kV, Dyn11Dzn0
Distribution transformer for cogeneration Plant auxiliaries	1.6MVA, 11/0.415kV, Dyn11
Interconnection transformer at sugar Plant	10/13MVA, 11/6.9kV, Dyn11
Lighting Transformer	Zn0 windings, 50A for 10Sec & 500A for 3Sec, 11KV, ONAN
Neutral Grounding Transformer	Min. [28/35] MVA [132/11] kV YNd1

8.11 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]

8.12 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.

8.13 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.

8.14 RTDs & Thermistors

Thermistors shall be installed on motors rated between 50 to 1000 kW. RTD shall be made available for motors more than 500 kW. All RTDs shall be hooked up with relays in Motor Relays in respective MCC.

8.15 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 50 kA to suit the system requirement, through the 11 kV neutral point of TG. The 11 kV 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 11 kV system at the secondary side of Interconnection Transformer shall be provided with NGR grounding to limit earth fault current of 50A.

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

400V VSD transformer grounding system shall be as for 6 Pulse AC VSD drives – Solidly grounded.

400V 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.



8.16 Cable Installation

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

8.17 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.

8.18 Lighting & Small Power

Plant lighting loads shall be fed through two (2) Nos. of 400/400V, Dyn11 connected dry type lighting transformer of minimum rating of 200 kVA.

Emergency Lighting Distribution Board ("ELDB") shall be fed through inverter of minimum 20 kVA 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.

8.19 Plant Communication System

Plant communication shall be provided with following facility:

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

8.20 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)

8.21 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.

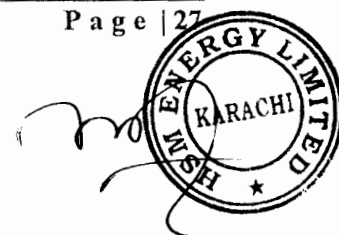
8.22 Instrumentation and Control ("I&C") Systems

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 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

8.23 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 a separate room with the window to the 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.

8.24 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 to permit safe maintenance, removal, testing and calibration of instruments during plant operation.

9 Operations and Maintenance (O&M)

The Facility will be a standalone operation under the management of the Plant Manager who shall oversee 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.

9.1 Maintenance of the Plant

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 sometime 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 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.

10 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)

10.1 Plant Generation Parameters

As discussed earlier, 26.50 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 HSML to the extent these are not met by the LP boiler. To meet the steam requirements of the HSML process, the current LP boiler along with a 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	25.98 MW	26.50 MW
Auxiliary Consumption of Turbine	2.34 MW	2.25 MW
Net Capacity from HP System	23.65 MW	24.25 MW
Net Exportable to Sugar Mill from HP System	1.69 MW	2.70 MW
Net Exportable to Grid from HP System	21.96 MW	21.55 MW
Exportable Units	49,585 MWh	44,782 MWh



10.2 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			7-Feb-17
EPC Activities	100	7-Feb-17	18-May-17
Grid Study, Approvals & CPPA-G Consent	100	7-Feb-17	18-May-17
Generation License Application and Approval from NEPRA	60	24-May-17	23-Jul-17
Tariff Application and Approval from NEPRA	30	24-May-17	23-Jun-17
Issuance of LOS	15	23-Jun-17	8-Jul-17
Signing of IA and EPA	60	8-Jul-17	6-Sep-17
Financial Close Activities	110	8-Jul-17	26-Oct-17
Construction Activities	600	26-Oct-17	18-Jun-19
Commercial Operations Date			18-Jun-19

10.3 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.

10.4 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 109.19/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	26.50	2,893.59
Non-EPC Cost	0.98	107.32
Project Development Costs	2.30	251.61
Insurance during Construction	0.27	28.94
Financing Fee & Charges	0.96	104.36
Interest during Construction (IDC)	2.21	241.13
Total	33.22	3,626.94
<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:
 - Land cost estimated at USD 0.50 million
 - Non-reimbursable fuel during testing at USD 0.48 million based on an estimated bagasse consumption of 15,000 MT.
- **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 as 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 1.00% 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).

10.5 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:

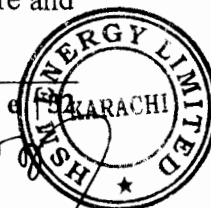
Table 19: Project Funding

Project Cost	PKR 3,626.94 million
Debt	PKR 2,901.55 million
Equity	PKR 725.39 million
Lending Rate	9.44% (3-month KIBOR + 3.0%)
Repayment Period	10 years
Repayment Frequency	Quarterly
Annual Installment	PKR 451.51 million

10.6 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.

10.7 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 HSML. 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 HSML
- Sale of steam to HSML

10.8 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.

10.9 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.



10.10 Projected Income Statement

PKR million	1	2	3	4	5	6	7	8	9	10
REVENUE										
Power to Sugar Mill	117	117	117	117	117	117	117	117	117	117
Power to CPPA-G	1,178	1,178	1,178	1,178	1,178	1,178	1,178	1,178	1,178	1,178
Steam for Sugar Mill	87	87	87	87	87	87	87	87	87	87
Total Revenue	1,383	1,383	1,383	1,383	1,383	1,383	1,383	1,383	1,383	1,383
Bagasse Cost	683	683	683	683	683	683	683	683	683	683
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	36	36	36	36	36	36	36	36	36	36
Total O&M Cost	97	97	97	97	97	97	97	97	97	97
Insurance Cost	31	31	31	31	31	31	31	31	31	31
Depreciation	121	121	121	121	121	121	121	121	121	121
EBIT	452	452	452	452	452	452	452	452	452	452
Working Capital Cost	22	22	22	22	22	22	22	22	22	22
Interest on LT Loan	268	250	230	208	184	158	129	98	63	25
Net Income	162	180	200	221	245	271	300	331	366	404

10.11 Projected Balance Sheet

PKR millions	1	2	3	4	5	6	7	8	9	10
Fixed Assets	3,506	3,385	3,264	3,143	3,022	2,902	2,781	2,660	2,539	2,418
Advance	-	-	-	-	-	-	-	-	-	-
Accounts Receivable	-	-	-	-	-	-	-	-	-	-
Debt Reserves	-	-	-	-	-	-	-	-	-	-
Cash	-	-	-	-	-	-	-	-	-	-
Total Current Assets	-	-	-	-	-	-	-	-	-	-
Total Assets	3,506	3,385	3,264	3,143	3,022	2,902	2,781	2,660	2,539	2,418
Accounts Payable	-	-	-	-	-	-	-	-	-	-
Working Capital	-	-	-	-	-	-	-	-	-	-
Debt Current Portion	202	222	243	267	293	322	354	388	426	-
Current Liabilities	202	222	243	267	293	322	354	388	426	-
Long-term Debt	2,516	2,294	2,050	1,783	1,490	1,168	814	426	-	-
Total Liabilities	2,718	2,516	2,294	2,050	1,783	1,490	1,168	814	426	-
Paid-up Capital	725	725	725	725	725	725	725	725	725	725
Retained Earnings	63	144	245	368	514	686	888	1,120	1,387	1,693
Total Equity	788	870	970	1,093	1,239	1,412	1,613	1,846	2,113	2,418
Equity & Liabilities	3,506	3,385	3,264	3,143	3,022	2,902	2,781	2,660	2,539	2,418



10.12 Projected Cash Flows

PKR millions	1	2	3	4	5	6	7	8	9	10
Earnings after tax	162	180	200	221	245	271	300	331	366	404
Add: Depreciation	121	121	121	121	121	121	121	121	121	121
Change in Advances	-	-	-	-	-	-	-	-	-	-
Change in A/C Receivable	-	-	-	-	-	-	-	-	-	-
Change in A/C Payable	-	-	-	-	-	-	-	-	-	-
Cash Flow from Operations	283	301	320	342	366	392	421	452	487	525
Cash Flow from Investment	-	-	-	-	-	-	-	-	-	-
Repayment of LT Debt	(184)	(202)	(222)	(243)	(267)	(293)	(322)	(354)	(388)	(426)
Repayment of WC Loan	-	-	-	-	-	-	-	-	-	-
Disbursement of Equity	-	-	-	-	-	-	-	-	-	-
Cash Flow from Financing	(184)	(202)	(222)	(243)	(267)	(293)	(322)	(354)	(388)	(426)
Net Cash Flow	99	99	99	99	99	99	99	99	99	99

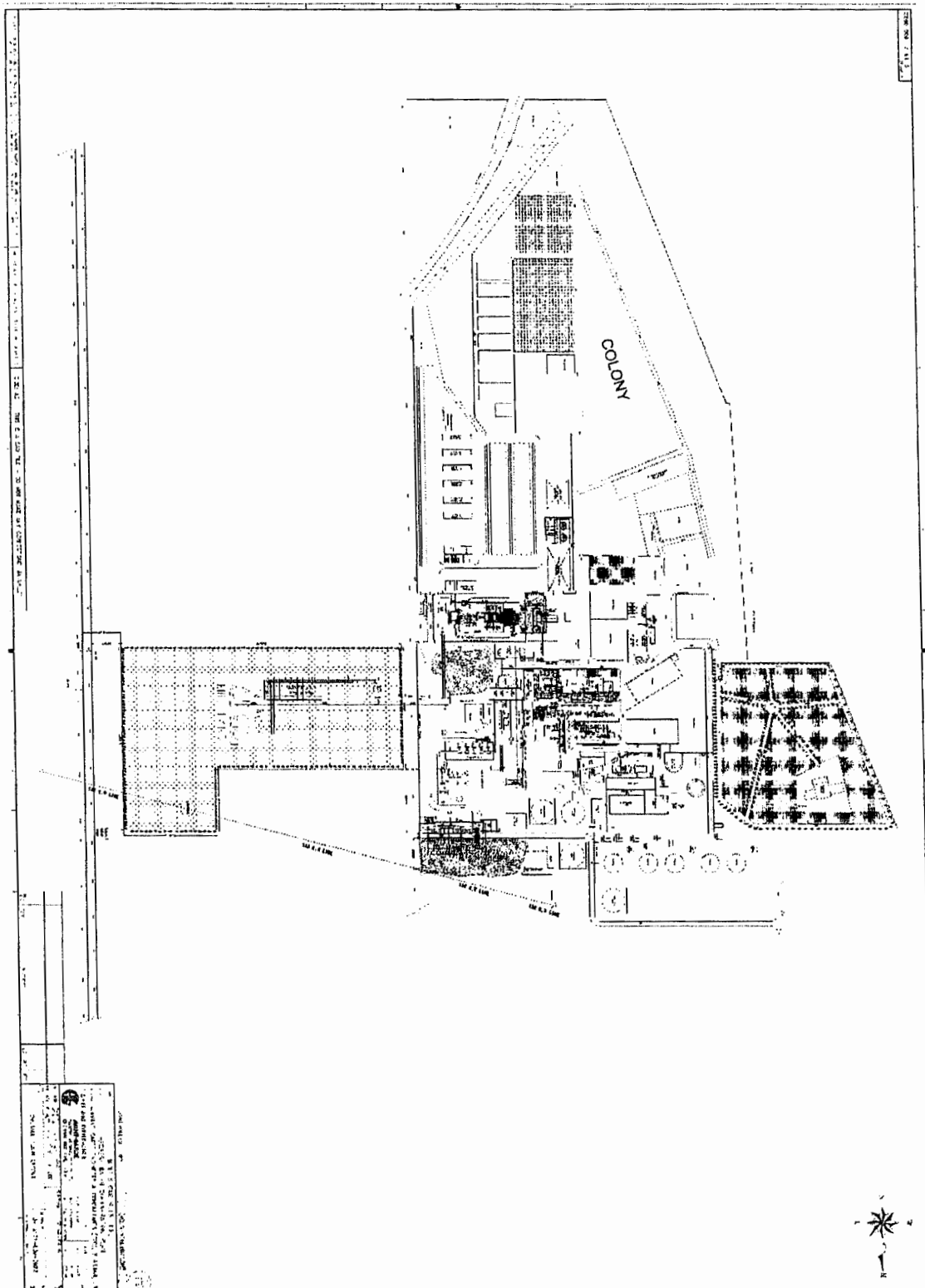


11 Financial Summary

	Min.	1	2	3	4	5	6	7	8	9	10
Revenue	1,383	1,383	1,383	1,383	1,383	1,383	1,383	1,383	1,383	1,383	1,383
EBITDA	573	573	573	573	573	573	573	573	573	573	573
Net Income	162	162	180	200	221	245	271	300	331	366	404
Dividends	99	99	99	99	99	99	99	99	99	99	99
Annual Interest	48	290	272	252	230	207	181	152	120	86	48
Debt Servicing	474	474	474	474	474	474	474	474	474	474	474
Debt to Equity	0.00	3.45	2.89	2.36	1.88	1.44	1.06	0.72	0.44	0.20	0.00
Times Interest	1.98	1.98	2.11	2.27	2.48	2.77	3.17	3.77	4.76	6.68	11.98
DSCR	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21	1.21
Loan Life Cover Ratio	1.16	1.16	1.17	1.17	1.18	1.18	1.19	1.19	1.20	1.21	1.21



12 Plant Layout (Annexure 1)



PROSPECTUS

Introduction of Applicant

Habib Sugar Mills Limited ("HSML"), through a wholly-owned subsidiary, HSM Energy Limited intends to set up a green field 26.50 MW (Gross) high-pressure bagasse based co-generation power plant (the "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 HSML located at Nawabshah, District Shaheed Benazirabad, 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 as partially meet the steam and power requirements of HSML during the crushing season. The Project will enable HSML to establish a sustainable market for its by-product, bagasse, and will also allow the sponsors 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

The broad parameters of the project are as under:

Project Capacity	26.50 MW (Gross)
Project Location	Nawabshah, District Benazirabad, Sindh
Land Area	20.6 Acre
Construction Period	20 months
Technology	Bagasse/Bio-Mass
Power Purchaser	CPPA-G
Steam Turbines	1x26.50 MW extraction cum condensing
Boilers	1x130 TPH, 110 bar 540°C
Upfront Levelized Tariff	US cents 10.62 per kWh

Proposed Investment

The total cost for the project is approx. to PKR 3,627 million, which is expected to be financed in a debt to equity ratio of 75:25.

Social and Environmental Impact of the Proposed Facility

Bagasse-based cogeneration offers several advantages both to the sugar industry and to the country. Besides reducing the gap between the demand and supply in the power sector, bagasse-based cogeneration provides an environmentally friendly solution for additional power generation, reduces dependence on fossil fuels, eases the pressure on foreign exchange outflow from the country for import of fossil fuels and gives the sugar industry financial gains in the form of cheaper energy.



Schedule III

General Information

(i)	Applicant's Name	HSM Energy Limited
(ii)	Registered Office	3 rd Floor, Imperial Court, Dr. Ziauddin Ahmed Road, Karachi - 75530
(iii)	Plant Location	Nawabshah, District Shaheed Benazirabad, Sindh
(iv)	Type of Generation Facility	Bagasse fired Cogeneration Power Plant
(v)	Commissioning/Commercial Operation Date	June 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

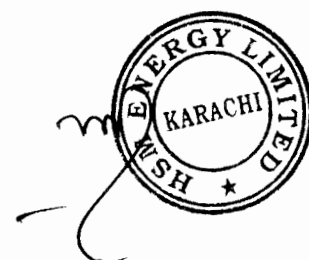
- Site map attached as Annexure -1
- The Project will be located adjacent to HSML located at Nawabshah, District Shaheed Benazirabad, Sindh, Pakistan. Approximately 20.6 acres will be allocated to the construction of the power plant.

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)	26.50 MW (Gross)
(iii)	Number of Units	One (01)
(iv)	Unit make, model & year of manufacture	2017
(vi)	Available Capacity	Power Generation: 25.98 MW (Season operation) 26.50 MW (Off-season operation)
(v)	Auxiliary Consumption	Approximately 9.0 %

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

(i)	Primary Fuel	Bagasse
(ii)	Alternate Fuel	NIL
(iii)	Fuel Source (Imported/Indigenous)	Indigenous
(iv)	Fuel Supplier	Habib Sugar Mills Limited
(v)	Supply Arrangement	Through conveyor belts/loading trucks/tractor trolleys etc.,



(vi)	Sugarcane Crushing Capacity	437.5 TPH
(vii)	Bagasse Generation Capacity	131.25 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
(i)	SO _x (mg/Nm ³)	Less than 774
(ii)	NO _x (mg/Nm ³)	Less than 100
(iii)	CO ₂	Nil
(iv)	CO (mg/Nm ³)	Less than 100
(v)	PM ₁₀ (mg/Nm ³)	Less than 150

5. Cooling Water Source

(i)	Cooling Water Source/Cycle	Canal Water / RCC Counter Flow Cooling Tower of Capacity 6600 m ³ /hr
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6. Interconnection

(i)	Nearest Grid Facility	Grid Station II, Sanghar Road, Nawabshah
(ii)	Distance of Grid from Project Site	4.5 km
(iii)	Voltage Level	132 kV
(iv)	Single Line Diagram	Attached as Annexure -2

7. Infrastructure

(i)	Road	This power plant will be installed at Nawabshah, district Benazirabad, Sindh, Pakistan. The site by road is 4 hours' drive from the country's largest city and commercial capital Karachi on the National Highway N-5, roughly 50 kilometres from left bank of River Indus and 28 Km from The National Highway. The central geographical location of the city makes it a major train and road transportation hub in the province. The purposed site is situated at 26.15°N North latitude, 68.25°E East longitude and 33.5 meters elevation above the sea level.
(ii)	Rail	Main Railway Track is passing next to Habib Sugar Mills Limited and the nearest railway station is 1.5 KM from the project site.
(iii)	Staff Colony	The existing colony of Habib Sugar Mills Limited will be utilized by the staff of the Proposed Project. The colony is constructed over 47 acres area and has all sort of facilities to the residents like Masjid, Madresa, children park, playground, bungalows, labour housing colony, Workers' club, cricket ground, table tennis, tennis



		court, and other amenities. Safe filtered water, electricity, gas and generator facilities are also available for the residents.
(iv)	Amenities	School: One Free private Secondary school as HSM CSR project is situated in the colony. Bus services from Colony / Mills to City: Free school bus service from colony to city is available every day. Medical facilities: A well-equipped dispensary with paramedical staff and ambulance is available 24 hours to meet any emergency to workers and staff.

8. Project Cost and Financing

Estimated Project Cost*	PKR million
EPC Cost	2,893.59
Non-EPC Cost	107.32
Project Development Costs	251.61
Insurance during Construction	28.94
Financing Fee & Charges	104.36
Interest during Construction (IDC)	241.13
Total	3,626.94
Debt	2,901.55
Equity	725.39

9. Project Commencement and Completion Schedule

Activity	Duration	Start Date	End Date
Issuance of LOI			7-Feb-17
EPC Activities	100	7-Feb-17	18-May-17
Grid Study, Approvals & CPPA-G Consent	100	7-Feb-17	18-May-17
Generation License Application & Approval from NEPRA	60	24-May-17	23-Jul-17
Tariff Application and Approval from NEPRA	30	24-May-17	23-Jun-17
Issuance of LOS	15	23-Jun-17	8-Jul-17
Signing of IA and EPA	60	8-Jul-17	6-Sep-17
Financial Close Activities	110	8-Jul-17	26-Oct-17
Construction Activities	600	26-Oct-17	18-Jun-19
Commercial Operations Date			18-Jun-19

10. Environment and Social Soundness Assessment

Report attached as Annexure -3

11. Safety and Emergency Plans



Attached as Annexure -4

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

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

13. Plant Characteristics

(i)	Generation Voltage	11,000 Volts	
(ii)	Frequency	50 Hz	
(iii)	Power Factor	0.8 (Lag) & 0.95 (Lead)	
(iv)	Automatic Generation Control (AFG)	Through Woodward Governor System	
(v)	Ramping Rate	Approximately 270 rpm	
(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) During warm start (i.e. when plant is started at less than 36 hours after shutdown) During Hot start (i.e. when plant is started at less than 12 hours after shutdown)	a. Cold Start – 360 minutes b. Warm Start – 180 minutes c. Hot Start – 120 minutes

14. Control, Metering, Instrumentation and Protection

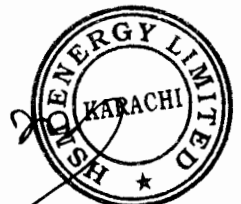
Attached as Annexure -6.

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.

16. Efficiency Parameters

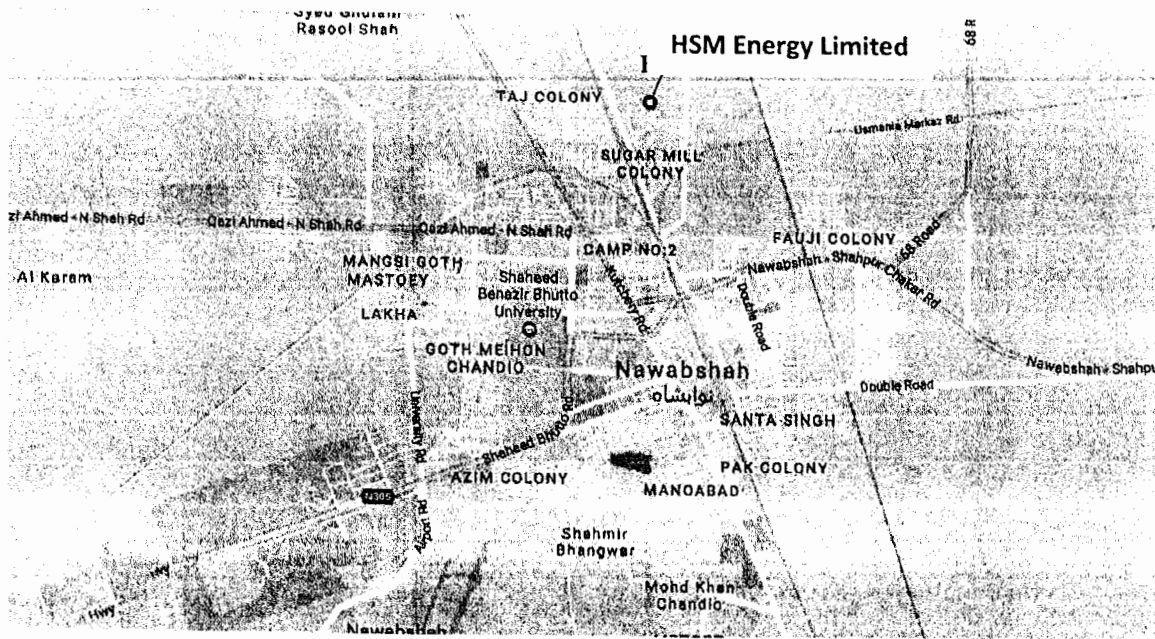
	Season	Off-Season
Gross Efficiency*	24.11%±0.50%	31.32%±0.50%
Net Efficiency*	22.22%±0.50%	28.87%±0.50%
Design Efficiency	22.22%±0.50%	28.87%±0.50%

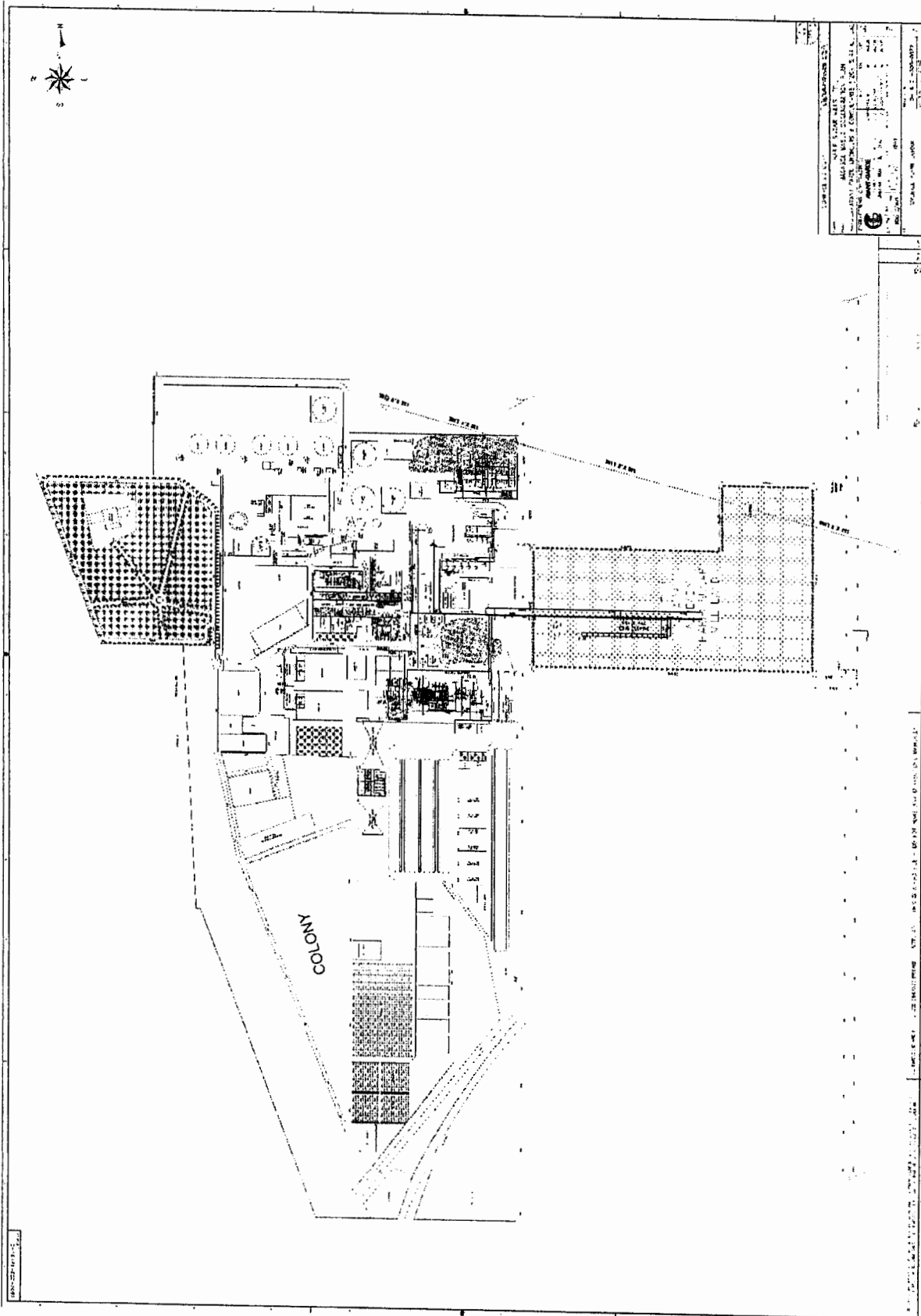
*The above figures are feasibility level numbers based on 110 bar boiler. The above efficiency numbers are expected at the time of COD of new plant and will deteriorate over the life of the project.



Annexure - 1

SITE MAP & LAYOUT DIAGRAM





Annexure – 2

**SINGLE LINE
DIAGRAM**



Annexure - 3

**Initial Environment
Examination Report**





Habib Sugar Mills Limited

3rd/4th FLOOR, IMPERIAL COURT, DR. ZIAUDDIN AHMED ROAD, KARACHI-75530 (PAKISTAN)

Ref: HSM/COGEN/008/2017

April 17, 2017

To
The Director General
Sindh Environmental Protection Agency
Government of Sindh
Karachi.

SUBJECT: SUBMISSION OF INITIAL ENVIRONMENTAL EXAMINATION

Please find enclosed herewith the Initial Environmental Examination of HSM Energy Limited, District Shaheed Benazirabad, Sindh, in compliance with Sindh Environmental Protection Act, 2014 along with the necessary documents for your kind perusal and approval.

Kindly acknowledge and oblige

Best Regards,

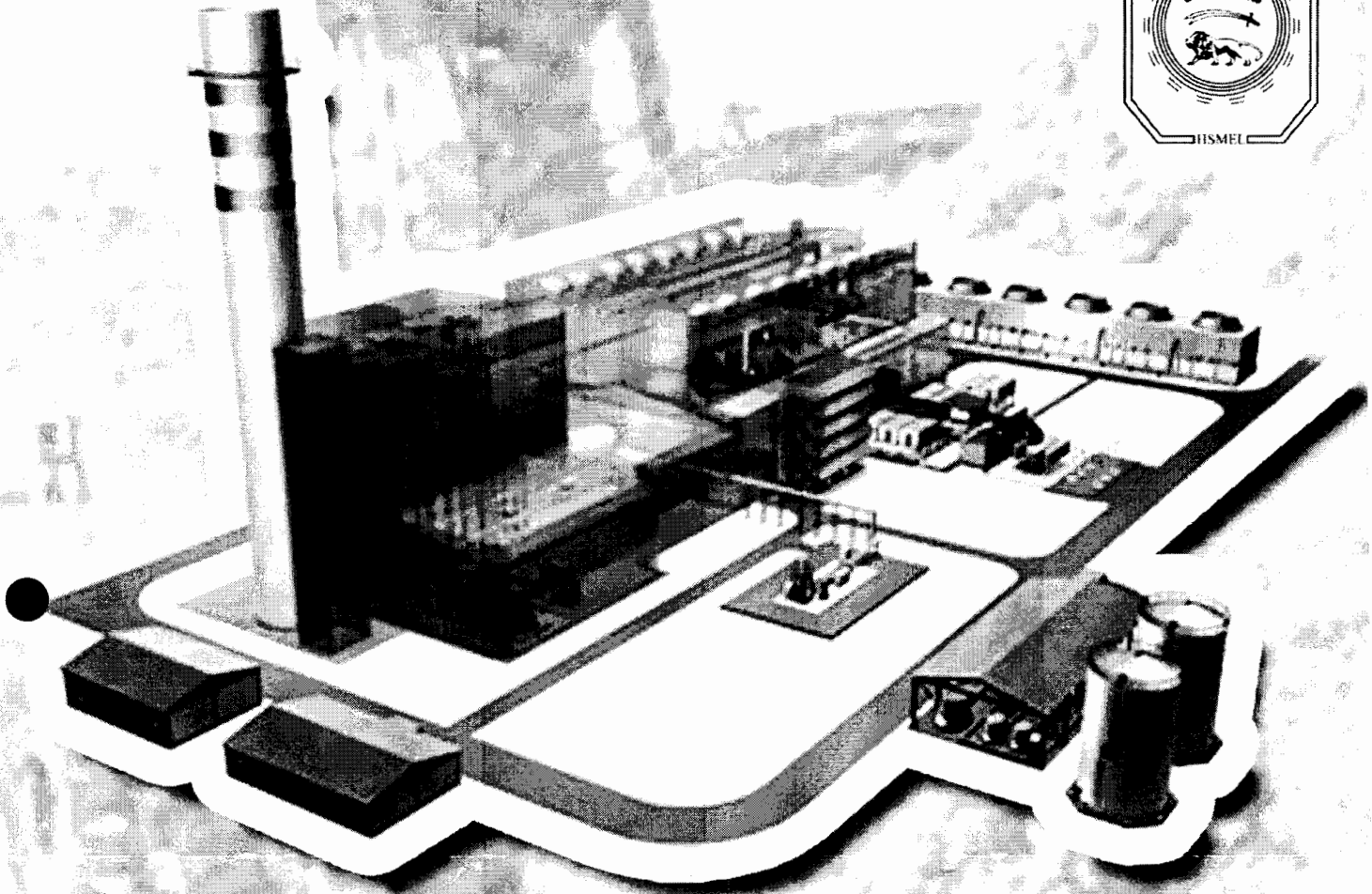
Amir Bashir Ahmed

For HSM Energy Limited

Enclosed:

1. Initial Environmental Examination
2. Schedule V form
3. Pay Order of PKR 100,000/- in the name Sindh Environmental Protection Agency, Government of Sindh on account of processing fee.





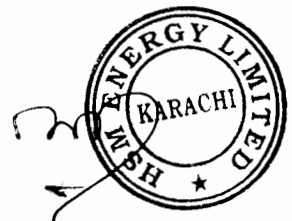
HSM ENERGY LIMITED

Nawabshah, Dist. Shaheed Benazirabad, Sindh

INITIAL ENVIRONMENTAL EXAMINATION



**Environmental
Total
Solutions**



INITIAL ENVIRONMENTAL EXAMINATION

HSM ENERGY LIMITED

**Nawabshah, District Shaheed
Benazirabad, Sindh**

Developed by:

ENVIRONMENTAL TOTAL SOLUTIONS

**Office No. 1, Aqsa Tower, Gulshan-e-Iqbal,
Main Rashid Minhas Rd., Karachi**

Contact: 0333-2277350

Email: etspak1@gmail.com



EXECUTIVE SUMMARY

Introduction

Pakistan currently faces severe power shortages, which result in frequent long drawn out load shedding. Frequency plus duration of the load shedding is also on the increase. Irregularity and unavailability of power has led businesses to fail and Pakistani families to struggle. The power shortage is well documented by the Government of Pakistan (GoP) and is estimated at over 6,000 MW. This gap in power supply and demand is on the increase.

Pakistan is an energy deficit country. Fossil fuels, which are already in short supply, and the available are fast depleting. On the other hand their industrial use is fast on the increase. In order to meet the present day requirements of the fuels and to fulfill the future increased demand, alternate/non conventional fuels are to be inducted without losing any time. With increasingly more disparity between energy supply and demand, and keener attention of the Government to environmental protection, use of non conventional energy resources i.e. use of Bagasse as a primary fuel for power generation could win favor from the governments' policies.

In this background Habib Energy Limited is planning to install a 26.5 MW Cogen Power Plant using Bagasse as a fuel which is a byproduct of the sugar production process, at Nawabshah, District Benazirabad, Sindh, Pakistan.. This area falls within the jurisdiction of the Environmental Protection Agency (EPA), Government of the Sindh, Karachi. Accordingly, the report is being submitted to the EPA, Karachi, for its Environmental Approval (EA).

The project proponent is planning, to enhance Co-generation program by adding a 135 TPH boiler with the out let steam parameters of 110 bar and 540 Deg. C and a 26.5 MW extraction condensing turbo generator. The process of power



production will be based on the technology of direct combustion of bagasse in the boiler to produce steam and this steam will be provided to the turbo generators to convert thermal energy in the electrical energy.

Bagasse is the matted cellulose fiber excess from sugarcane that has been processed in a sugar mill. Previously, bagasse was burned as a means of solid waste disposal. However, as the cost of fuel oil, natural gas, and electricity increased after the energy crisis in 1970, special attention was paid to alternative fuels in an efficient way. Consequently, conception of bagasse combustion changed and it has come to be regarded as a biomass fuel rather than refuse.

Another important aspect is the increasing demand of bagasse as raw material for paper, furniture, and other industries. For all these reasons, the saving of this product has become one of the main objectives of the sugar cane industry. The actual affinity is to use bagasse as fuel, especially for Co-generation of electric power and steam, to increase its contribution to the country's energy supply.

Purpose of the report

According to the Sindh Environmental Protection Act, 2014, Section 17 "Initial environmental examination and environmental impact assessment,

"No proponent of a project shall commence construction or operation unless he has filed with Government Agency designated by Federal Environmental Protection Agency or Provincial Environmental Agencies, as the case may be, or, where the project is likely to cause an adverse environmental effects an environmental impact assessment, and has obtained from the Government Agency approval in respect thereof."

Category of the project

The power plant is to produce 26.5 MW electricity from bagasse as a fuel, therefore, according to the 'Sindh Environmental Protection Agency (Review of IEE and EIA) Regulations, 2014" the project falls in "Category B" requiring IEE to be



submitted to SEPA, for getting Environmental Approval (EA). This IEE report has been prepared, according to the “Guidelines for the preparation and review of Environmental Reports, October 1997/2000”

The power plant will cover approximately total of 51395 sq. meters as covered area and 29542 sq. meters as bagasse yard in the close vicinity premises to the Habib Sugar Mill. The total estimated cost of the power plant is Pak Rs. 03 Billion. The report takes into account the environment related rules, regulations and laws.

Raw Materials

The only raw material for this project is Bagasse, which is a by-product of the sugar production process. The Co-generation power plant will use bagasse mainly produced by Habib Sugar Mills Ltd. Bagasse has a heating value between 3,000 and 4,000 British thermal units per pound (Btu/lb) on a wet, as fired basis. Most bagasse has moisture content between 45 and 55 percent by weight. Major equipment required for the plant has also been listed in this report.

Waste Handling

All Waste water generated will be taken to the effluent treatment plant and will be bring to the levels as required by the SEQS Pakistan. Ash Handling System will be installed. Bagasse ash from the boiler will be disposed off as manure / fertilizer and also made available to other growers in the region. Any solid waste requiring recycling or reuse will be sold in the market to the contractor and all the adequate record will be maintained.

Gaseous Emissions

Emissions of Sulfur dioxide (SO₂) and Nitrogen oxides (NO_x) are lower than conventional fossil fuels due to the characteristically very low levels of Sulfur and Nitrogen associated with bagasse. The most significant pollutant emitted by bagasse fired boilers is Particulate Matter (PM), caused by the turbulent movement of combustion gases with respect to the burning bagasse and resultant ash. Stack PM will be controlled by the use of electrostatic precipitators for each boiler to meet the permitted dust concentration as required by SEQS.



Power plant noise level of 75 dB (A) and 65 dB (A) will be maintained at the boundary walls of the project as per guidelines provided in the SEQS. Further Noise level of Maximum 85 dB (A) will be maintained at 1.0 m from the equipment.

Environment Management Plan

The report provides comprehensive Environment Management Plan both for managing environment during construction and regular operation. Comprehensive onsite monitoring on the project was carried out to ascertain the levels of the baseline environmental status before commencing any work on the project.

Conclusion

In conclusion it was found that the project is fully justified for the installation at the earliest in view of the so frequent and long drawn out load shedding.



ABBREVIATIONS AND ACRONYMS

AAQ	Ambient Air Quality
ADB	Asian Development Bank
BOD	Biochemical Oxygen Demand
CHP	Combined heat and power
CWDS	Circulating Water Discharge System
CO ₂	Carbon dioxide
CH ₄	Methane
DO	Dissolved Oxygen
EAF	Equivalent Availability Factor
EHS	Environmental Health and Safety
EIA	Environmental Impact Assessment
EMS	Environmental Management Staff
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
HSE	Health, Safety and Environment
HESCO	Hyderabad Electric Supply Company
HGVs	Heavy Goods Vehicles.
IPP	Independent Power Producer
ISG	Integrated Steam Generator
IUCN	International Union for Conservation and Natural Resources



SEQS	Sindh Environmental Quality Standards
NTDC	National Transmission and Dispatch Company
NOC	No Objection Certificate
NO _x	Oxide of Nitrogen
O ₃	Ozone
PEPA	Pakistan Environmental Protection Agency
PEPCO	Pakistan Electric Power Company
PEPC	Pakistan Environmental Protection Council
PM ₁₀	Particulate Matter (10µgm ³ size)
PM _{2.5}	Particulate Matter (2.5µgm ³ size)
SS	Suspended Solids
STG	Steam Turbine Generator
SDPI	Sustainable Development Policy Institute
SO ₂	Sulfur dioxide
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TSS	Total Suspended Solids
WHRB	Waste heat recovery boilers
WWF	Worldwide Fund





UNITS

dB(A)	Decibel (A-rated)
Ft	feet
Ft ²	Square foot
ha	Hectare (1 hectare = 2.47 acres)
Km	Kilometer
Km ²	Square Kilometer
Km/h	Kilometer per hour
KWh	Kilo Watt per hour
°C	Degree Celsius
MGD	Million Gallons per Day
MT	Metric Ton
MW	Mega-Watt (One million watt)
MWe	Mega-Watt electrical
mg/Nm ³	Micro gram per normal cubic meter
mph	Miles per hour
m ²	Meter Square
m ³	Cubic meter
Nm ³ /h	Normal cubic meter per hour



Sq. Km Square Kilometer

TPD Tones per Day

TERMS USED IN POWER GENERATION

Abatement Effort to avoid emission of Carbon Dioxide

Barring The process of slowly turning the Turbine-Generator shaft to prevent bowing while it is still
hot after shutdown

Biomass Living or recently dead material such as plant matter, used as either fuel or industrial
production as bio-fuel

Clean Fuel Fuel that has been modified such that, on combustion, it produces lower emissions



Co-generation	A particularly efficient method of electricity generation that diverts heat produced as a by-product of the power generation process, to domestic and industrial heating systems.
Combined cycle power plant:	Conventional thermal power stations produce steam to drive turbines that generate electricity. In a combined cycle plant, two turbines are used. The first turbine and waste heat from that process contributes to the production of steam to drive the second turbine
Emissions	The release or discharge of substances, effluents or pollutants into the environment
Feeder	Over head lines that are used to distribute electrical power to consumers. Feeders connect distribution substations and consumers.
Generator	A device that converts rotating mechanical movement into electric power
Greenfield	A new field development requiring new facilities, either onshore or offshore
Heat Rate	The amount of fuel energy required to produce electrical energy
Load	A load in electrical terms is the power consumed by a device or a circuit. Load is also used to describe the total of all electricity consumers in a power system.
Power factor	Power factor is the ratio of real power to reactive power in an electric circuit and a measure of whether the system's voltage and current are "in phase."
Turbine	A propeller-like device that is turned by a stream of hot gas (steam in a conventional thermal power station), water (in a hydro plant), gas (in a gas power plant)
Water Injection	The process where water is injected back into the oil reservoir to maintain or increase pressure and stimulate production.

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INTRODUCTION

1.1 INTRODUCTION

Pakistan currently faces severe power shortages, which result in frequent long drawn out load shedding. Frequency as well duration of the load shedding is also on the rise. Unreliability and unavailability of power has led businesses to fail and Pakistani families to struggle. The power shortage is well documented by the Government of Pakistan (GoP) and is estimated at over 6,000MW. This gap in power supply and demand is on the rise.

The demand and supply of electricity was balanced in 1997 with the commissioning of private sector Independent Power Producers (IPPs) established under the Private Power Policy of 1994. As peak demand growth approached 6.6% per year during 2001 to 2007, the supply shortage occurred much earlier than 2009. In order to bridge the gap between power demand and supply, Pakistan Government liberalized its investment policies, which resulted in not only investments in power production sector from local resources, but also foreign investments, are pouring in large amounts.

Out of the total installed power generation capacity of 23,412 MW in 2010-- 11; 16,070 MW was thermal (69 percent), 6,555 MW was hydroelectric (28 percent) and 787 MW was nuclear (3 percent). The growth in energy supply continues to lag behind the growth in energy demand. Indigenous supply of fossil fuels is not only becoming short in supply, but also their fast price hike in the international markets is swelling import bills of the fossil fuels. Lacking adequate environmental controls, use of fossil fuels has already caused a lot of damage to the environment of the country.



Pakistan is an energy deficit country. Fossil fuels, which are already in short supply, and the availability is fast depleting whereas their industrial use is increasing rapidly. In order to meet the present day requirements of the fuels and to fulfill the future increased demand, alternate/non-conventional fuels are to be inducted without losing any time.

With increasing disparity between energy supply and demand, and keener attention of the Government to environmental protection, use of non-conventional energy resources i.e. use of bagasse as a primary fuel for power generation could win favor from the Governments' policies. Fragile economy of Pakistan cannot afford to continue importing fossil fuels and spending hard earned foreign exchange. Under these circumstances, there is an immediate need to find a practical solution whereby, the dire need for electricity of the country could be met with minimum pressure on the National exchequer.

One among other solutions to the present state is to use locally available cheaper sources of energy production. In this background HSM Energy Limited is planning to install a 26.5 MW Cogen Power Plant using bagasse as fuel which is a byproduct of the sugar production process, at Nawabshah, district Benazirabad, Pakistan.

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.

Under the present operating condition, the entire steam and power requirement of the Habib Sugar Mills Limited are being met by the boilers and turbo generators already installed in the sugar mills. The mill has (06) low-pressure (25 bar) boilers and (01) High-Pressure (62 Bar) boiler with the Total capacity of 245 TPH and 05 backpressure turbo generators with the capacity of 13.5MW for meeting the internal steam and power requirement.



The cane being crushed by the sugar mill has high fiber content and cane bagasse percentage on the average is 32%. The sugar mill crushes for a period of 110 days/year.

1.2 SPECIFICATIONS OF THE PROJECT

The project proponent is planning, to enhance Co-generation program by adding a 135 TPH boiler with the out let steam parameters of 110 bar and 540 Deg. °C and a 26.5 MW extraction condensing turbo generator. The process of power production will be based on the technology of direct combustion of bagasse in the boiler to produce steam and this steam will be provided to the turbo generator to convert thermal energy in the electrical energy.

During the season, the sugar mill operating at 10,500 TCD crushing will need 8,895 kW of power for its operation. The new 135 TPH boiler and 26.5 MW extraction condensing turbo generator will consume an auxiliary power of 2,252 kW. The existing 09 MW turbine will run at 08 MW and will consume 850 kW for its auxiliaries. Sugar mill will also require 8.895 MW from power project. With the gross power generation of 34,400 kW and in-house power consumption at 12,116kW, the electrical power export during the season works out to 22,284kW. With 90% capacity utilization, the electrical energy export during the season of 110 days works out to 47.06million units (kWh).

For 110 days of crushing operation at 90% capacity utilization, the saved bagasse at the end of the season will be 30,520 MT. Additional 195,900 MT of bagasse will be purchased from third party. Hence total available bagasse for off-season operations will be 226,420 MT. Operating in the condensing mode in the off-season, the 135 TPH boiler and 26.5 MW turbo generator will generate a gross power of 26.5 MW. The 135 TPH boiler actual steam generation will be 105 TPH under this mode of operation. From the gross 26.5 MW power production, 4,952kW will be required to meet sugar mill maintenance and auxiliary consumption within the power plant. The remaining balance of 21,547 kW will be exportable.



The bagasse consumption during off-season operation will be 43.88TPH. The available bagasse of 226,420 MT will enable to operate the 26.5 MW plant operations for 215 days. The exportable electrical energy for the 215 days of off-season operation will be 111.18 Million Units.

HSM Energy Limited has designed the Cogen plant with the aim of exporting power to grid both during crushing season and off season. This is how the supply of reliable and economic power to the National grid to meet ominous power demand of the country will be ensured and on the other hand the process steam demand of the Habib Sugar Mill will also continue to be met. This Initial Environmental Examination (IEE) report covers the activities related to this high pressure cogeneration power plant.

1.3 PURPOSE OF THE REPORT, IDENTIFICATION OF THE PROJECT, AND PROPONENT

Purpose of the report:

According to the Sindh Environmental Protection Act, 2014 (SEPA), Section 17 “Initial environmental examination and environmental impact assessment –

“(1) No proponent of a project shall commence construction or operation unless he has filed with Government Agency designated by Federal Environmental Protection Agency or Provincial Environmental Agencies, as the case may be, or, where the project is likely to cause an adverse environmental effects an environmental impact assessment, and has obtained from the Government Agency approval in respect thereof.”

It is this legal mandatory requirement that this IEE report regarding installation of 26.5 MW Cogen power plant using Bagasse as Fuel has to be submitted to the Sindh Environmental Protection Agency (SEPA), Government of the Sindh, before initiating any work for installing of the power plant under reference of this project.



According to the Sindh Environmental Protection Agency (Review of IEE and EIA) Regulations, 2014 (Schedule-II), the project of installation of power plant below 50 MW falls in schedule category "B". All out environmental monitoring of the plant will be carried out on bi-annually basis by a third party and be reported to the EPA Sindh. The IEE Report has been prepared following the format as provided under serial 2.3 of the "Guidelines for the preparation and review of Environmental Reports, October 1997/2000" –(Annex—III) presented in Annexure-I. It provides necessary information about the project under reference for its consideration by the Sindh EPA, Government of the Sindh, for decision making before the requested Environmental Approval (EA) is awarded for the project to start development in compliance with the Sindh Environmental Protection Act, 2014, Section 12.

Identification of the project & the proponent:

Recognizing the demand for natural commodities, the Dawood Habib group set up sugar and textile mills in the 1960s. During the years, the sugar division expanded into allied manufacturing setting up a distillery plant to produce Industrial Alcohol which further led to the conversion into Ethanol Fuel and conserving Carbon dioxide (CO₂) by installation of liquidified CO₂ plant. Today, the Dawood Habib group is involved in the manufacturing of Sugar, CO₂, Ethanol, Textiles and major supplier to beverage and food processing companies.

The project:

In view of acute shortage of electricity in Pakistan, all segments of life be it industry, commerce, social, domestic or else are facing lot of hardships. HSM Energy Limited is planning to install a 26.5 MW Cogen power plant using Bagasse as Fuel at Nawabshah, district Benazirabad, Sindh, Pakistan.

HSM Energy Limited would like to go for Cogen power plant with the aim of exporting power to electricity grid both during crushing season and off season. This is how the supply of reliable and economic power to the national Grid to meet ominous power demand of the country will be ensured and on the other hand the process steam demand of the sugar mill will continue to be met.



1.4 LOCATION OF THE PROJECT

This power plant will be installed at Nawabshah, district Benazirabad, Sindh, Pakistan. The site by road is 4 hours' drive from the country's largest city and commercial capital Karachi on the National Highway N-5, roughly 50 kilometers from left bank of River Indus. The central geographical location of the city makes it a major train and road transportation hub in the province. The purposed site is situated at 26.15°N North latitude, 68.25°E East longitude and 14 meters elevation above the sea level

Nature and size of the plant

HSM Energy Limited is planning to install a 26.5 MW Cogen Power Plant using bagasse as fuel. The covered area of power plant and bagasse yard will be 51,395 sq. meters and 29,542 sq. meters, respectively. The total estimated cost of the power plant is Pak Rs. 03 Billion.

1.5 EXTENT OF THE IEE STUDY, SCOPE OF THE STUDY

To get the Environmental Clearance from the Sindh Environmental Protection Agency it is required to carry out IEE for the proposed cogeneration power plant, deliberating the positive and negative impacts on the environment. A befitting 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 this study an independent monitoring consultant i.e. Environmental Total Solutions having their office at suit No. 1, Aqsa Centre, main Rashid Minhas Road, Karachi has been engaged.



This IEE study has been conducted in accordance with the requirements of the serial 3 of the “Guidelines for the preparation and review of SEPA Regulations 2014”. The scope of this IEE report briefly covers the followings:

Executive Summary

It contains a brief statement of the proposal covered in the report, background information, concise analysis and main conclusion.

Introduction

Introduction includes the purpose of this report, identification of the project and the proponents. Additionally, extent of the IEE study, scope of the study, magnitude of the effort, persons performing the study are also covered.

1.6 DISCUSSION OF THE PROPOSAL AND CURRENT LAND USE AND POLICIES INCLUDING RELEVANT ENVIRONMENTAL LAWS

Land Use in the Project Area:

The project site is situated in the lush agricultural region of District Shaheed Benazirabad, in the province of Sindh, Pakistan. The project area is famous for its sugarcane production and is surrounded by villages.



Description of project including:

- Type and category of the project
- Objectives of the project
- Alternatives considered, and reasons for their rejection.
- Location and related features
- Proposed schedule for implementation
- Description of the project, including drawing showing layouts, components of the project etc.
- Details of the restoration and rehabilitation plan at the end of the project life
- Government approvals and leases required by the project

Description of the Environment

(In the area affected by the project)

- Existing (baseline) condition of the biophysical and socio-economic environment, trends and anticipated future environmental conditions
- Physical resources topography, climate, surface water, soils, ground water, geology, seismology etc.
- Ecological resources, wild life , forest, rare or endangered species
- Human and economic development, population, communities, statistical data locations, compositions and employment
- Industries, including known major development project, infrastructure
- Water Supply, Sewage, flood control/ drainage etc.
- Institutions
- Transportation—roads, rail, harbor, air ports, navigable rivers
- Land use planning –including dedicated use areas
- Power sources and transmission



- Agricultural and mineral development

Quality of life values:

- Socioeconomic values
- Public health
- Recreational resources and development
- Aesthetic values
- Archeological historic treasures
- Cultural values

Screening of Potential Environmental Impacts and Mitigation Measures Including:

- Environmental problems resulting from project construction
- Environmental problems due to project location
- Environmental problems related to design
- Environmental problems resulting from project operations
- Potential environmental enhancement measures
- Additional consideration

Environmental Monitoring Programme and Institutional Requirements:

Environmental monitoring describes the processes and activities that need to take place to characterize and monitor the quality of the environment of the project in respect of which it has approved an initial environmental examination or environmental impact assessment to determine whether the actual environmental impact exceeds the level predicted in the assessment and whether the conditions of the approval are being complied with.

Scoping

Identify key issues to be considered in the EIA and related studies including:



- Details on the proponent
- Project characteristics
- Project location
- Potential impacts characteristics

Conclusions:

The conclusion confirms that the project is viable with respect to presence of dangerous unnatural ingredients causing imbalance in the ecosystems and health hazards to human beings and flora and fauna.

Recommendation

A suggestion or proposal as to the best course of action.

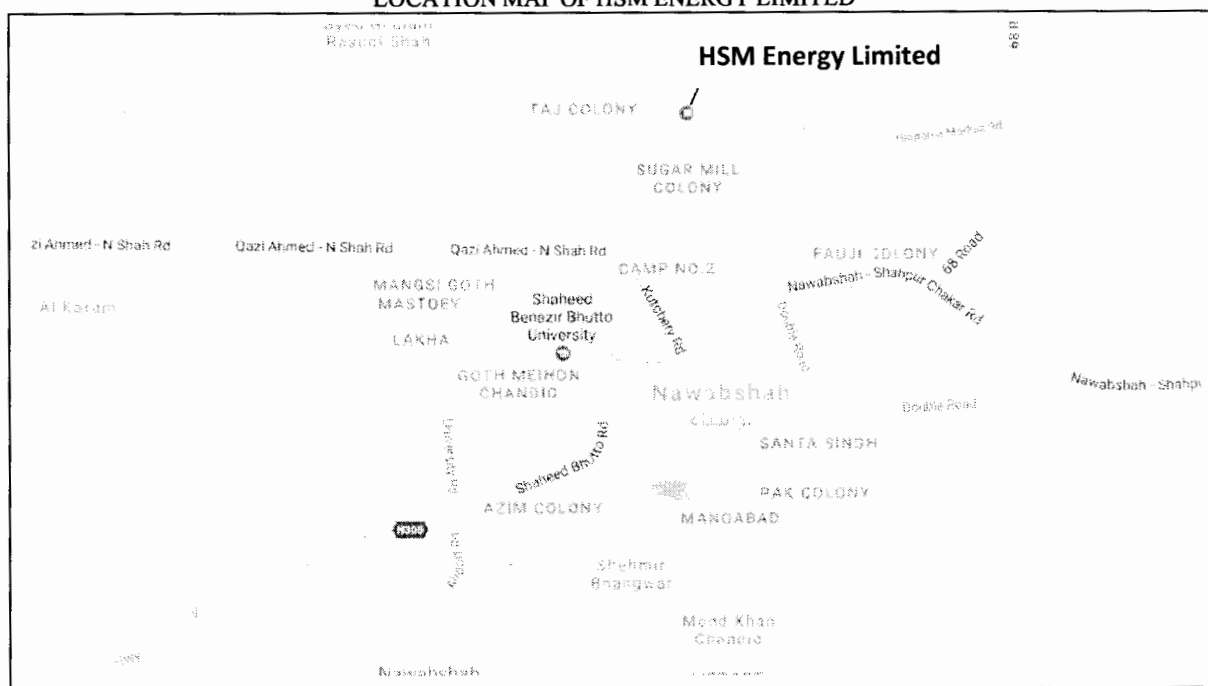
Salient Features of the Project Site

Feature	Particulars
Project Name	HSM Energy Limited
Registered Office / Head Office	3rd Floor – Imperial Court, Dr. Ziauddin Ahmed Road, Karachi 75530 Pakistan Telephone: +92 21 3568 0036 –9 FAX: +92 21 3568 4086
Location	HSM Energy Limited, P. O. Box 25 Nawabshah, District Shaheed Benazirabad, Sindh. Telephone: +92 244 360751 – 5 FAX: +92 244 361314
Installation Capacity	26.5MW
Net generation output	24.13MW
Latitude / Longitude	26.15°N North latitude, 68.25°E East longitude
Average altitude above mean MSL	29 m / 95 ft. meters elevation above the sea level



Temperature in °C	Average Maximum and minimum temperatures of 35.8° and 26.9°C respectively
Average Relative Humidity, Morning & Evening	79.5%, 39.1 % respectively
Total annual Rainfall in mm	149.4
Average Wind Velocity	3.5m/Sec
Soil Type	Fine sandy loam to silty clay loams
Railway Station	Nawabshah
Nearest City	Nawabshah
Nearest Water Body	Rohri canal (Khachar Distributory).
Sensitive locations like protected forests, monuments, national park, zoos etc	No sensitive location within 10 km radius

LOCATION MAP OF HSM ENERGY LIMITED







LEGISLATIVE & REGULARITY ASPECT

2.1 INTRODUCTION

The principal environmental regulatory agency in Pakistan was the Environmental Protection Agency (EPA) of Pakistan that formulates environmental policies, action plans and legislation. After the 18th amendment the environmental portfolio devolved to provincial governments. Consequently, the Sindh Environmental Protection Agency (SEPA) is empowered to formulate environmental legislation, rules, regulations and standards and their enforcement/ implement in the whole Sindh province as a formulating regulatory and monitoring agency. EPA Sindh's head office is located at ST-2/1, Sector-23, Korangi Industrial Area, Karachi.

Presently, the basic legislation on the environment is the Sindh Environmental Protection Act of 2014 (SEPA 2014), Sindh IEE/EIA regulations 2014 and other rules and regulations. SEPA has initiated process of notification for Sindh Environmental Quality Standards 2015 (SEQS 2015). In addition, EPA Sindh has also issued directions through print media and direct communication to the concerned parties for immediate compliance with these legislation and Rules and Regulations made so far.

This section provides synopsis of policies, legislation, and guidelines that may have relevance to the activities carried out by the HSM Energy Limited within the scope defined for this IEE/EMP. The relevant requirements of the policy documents and legislative framework have also been incorporated in the environmental management and monitoring plan being formulated for the better environmental impacts management. HSM Energy Limited management is committed to follow and comply with the relevant requirements of the policy documents and legislative framework for the better management of environmental aspects and impacts of their business related activities



2.2 NATIONAL ENVIRONMENTAL POLICY AND GUIDELINES

The enactment of comprehensive legislation on the environment, covering multiple areas of concern, is a relatively new and ongoing phenomenon in Pakistan. The following section presents a brief overview of the existing national policies and guidelines.

National Conservation Strategy (NCS)

The National Conservation Strategy (NCS) is the primary policy document of the Government of Pakistan on national environmental issues. The Policy was approved by the Cabinet in March 1992. The Strategy also attained recognition by international donor agencies, principally the World Bank. The NCS identifies 14 core areas including conservation of biodiversity, pollution prevention and abatement, soil and water conservation and preservation of cultural heritage and recommends immediate attention to these core areas in order to preserve the Country's environment.

The main objectives of the strategy are conservation of natural resources, sustainable development and improved efficiency in the use and management of resources. It covers fourteen key priority areas for policy formulation and intervention, including protecting watersheds, supporting forestry and plantations, protecting water bodies and sustaining fisheries, conserving biodiversity, increasing energy efficiency, developing and deploying renewable resources, preventing or decreasing pollution, managing urban wastes and preserving the cultural heritage. Energy policies include promoting efficiency and conservation as well as cogeneration, hydro, biogas, solar and new alternatives. The strategy also includes measures to control and limit pollution – for example, changing import duties to favor the most fuel-efficient vehicles, and regulate gasoline, kerosene and diesel pricing to make the least polluting alternatives the most affordable. Incorporation and integration of environmental and sustainable development themes into educational curricula and in the media is also an important feature of the strategy

National Environmental Policy



This policy covers all sectors and a wide range of means for promoting conservation and environmental protection in water, air and waste management, forestry, and transport. The policy aims to promote protection of the environment, the honoring of international obligations, sustainable management of resources, and economic growth. It calls for the setting of standards and regulations for ambient and indoor air quality, vehicle emissions and manufacture, energy conservation, fuel specification and building codes. It aims to promote mass transit and non-motorized transport as well as cleaner technologies, including, solar, hydroelectric, biogas and cogeneration with waste, and offering tax incentives for efficient products. It also calls for creating increased public demand for environmentally friendly products through education and mass awareness campaigns.

National Sanitation Policy

National Sanitation Policy of Pakistan provides a broad framework and policy guidelines to the Government to enhance and support sanitation coverage in the Country through the formulation of sanitation strategies, plans and programs at all respective levels for improving the quality of life of the people of Pakistan and the physical environment necessary for healthy life. The Policy will be implemented by the Federal, and Local Government Agencies in accordance with the guidelines, principles and measures spelt out in the policy.

2.3 ENVIRONMENTAL INSTITUTIONAL FRAMEWORK

Post 18th Amendment to the Constitution of Pakistan, the provincial Environmental Protection Agencies is fully empowered to initiate, modify and enforce environmental legislation in their respective provinces. In the province of Sindh, the EPA is the prime regulatory and monitoring institute. EPA is headed by a Director General (DG) who is the lead responsible person for enforcement of environmental legislation. He is also responsible for the guidance of other provincial departments/institutes on environmental matters and related issues. DG EPA Sindh functions from his registered head office located at Karachi, however, has regional offices in other major cities of the province functioning under senior officers.



EPA Sindh is attached with Environmental Protection Department (EPD) of Government of Sindh. The EPD, headed by a Secretary, is the administrative body and responsible for coordination with other line departments and agencies of the province. It also performs coordination and communication with other provinces and Federal Government Agencies.

2.4 ENVIRONMENTAL GUIDELINES

A. The Sindh Environmental Assessment EIA/ IEE Procedures 2014

In exercise of the powers conferred by Section 37 of the Sindh Environmental Protection Act, 2014, the Sindh Environmental Protection Agency, with the approval of Government of Sindh has notified the 'Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2014' vide notification No. EPA/TECH/739/2014 dated 16th December 2014.

This regulation describes the procedure for conducting environmental assessments and their approval process. Categories for projects requiring IEE, EIA or Environmental Checklists is mentioned in the regulation. The environmental assessment includes preparation of an Environmental Management Plan (EMP).

B. National Environmental Quality Standards (NEQS)

Government of Pakistan in early 1990s realized the importance of environmental pollution control by introducing National Environmental Quality Standards (NEQS) through statutory notifications as per recommendations of various advisory committees. Pakistan Environmental Protection Committee (PEPC) in its first meeting held on 10th May 1993 approved the NEQS. Later on, a set of NEQS was announced under SRO 742 (1) 93 dated 24th Aug 1993. These approved 32 parameters prescribing permissible levels of pollutants in liquid effluent while 16 parameters for gaseous emission were of uniform standards applicable to all kinds of industrial and municipal effluent.

Revised NEQS which were approved by the Council in December 28, 1999. These NEQS were made effective under SRO 549 (1) 2000 dated 8th August 2000.



The Council made amendments in S.R.O 742(1)/93 dated 24th August 1993 with its S.R.O. 72(KE)/2009 dated 16th May 2009.

- NEQS which were approved by the Pakistan Environment Protection Council. These NEQS for Municipal and Industrial effluent are attached.
- NEQS which were approved by the Pakistan Environment Protection Council. These NEQS for Industrial Gaseous Emissions, Motor Vehicle Exhaust, Noise and Ambient Air Quality are attached.
- NEQS which were approved by the Pakistan Environment Protection Council. These NEQS for Ambient Noise Level are attached.

After devolution of the subject of environment to the provinces (as per 18th Amendment), the Sindh EPA has initiated a process of notification of Sindh EQS. The drafts for all the said EQSs have been proposed and are in the process of approval. However, until SEQS are notified, the existing NEQS are the legal enforced standards that SEPA requires all industrial units to comply with. M/s HSM Energy Limited would comply with the limits of SEQS relevant to the scope of this EIA/EMP, however, once SEQS are notified; the same would be substituted in this EIA/EMP.

Self-Monitoring and Reporting

In exercise of the powers conferred by section 36 of the Sindh Environmental Protection Act, 2014, the Sindh Environmental Protection Agency, with the approval of the Government has notified the "Self-Monitoring and Reporting by Industry Rules, 2014" vide notification No. EPA/TECH/739/2014 dated 16th December 2014.

In 2014, the Government of Sindh has taken various concrete steps to attain control over industrial pollution in the Sindh Province. The most significant measure was the enactment of the Sindh Environmental Protection Act 2014, which makes it an obligation upon industrial facilities to restrict their air emissions and effluents to the limits specified in the Environmental Quality Standards (EQS).



2.5 NATIONAL ENVIRONMENTAL LEGISLATIONS

Pakistan Environmental Protection Act 1997

The Pakistan Environmental Protection Act (PEPA) was enacted on 6th December 1997, repealing the Pakistan Environmental Protection Ordinance, 1983. The PEPA' 1997 provides the framework for implementation of NCS, establishment of Provincial Sustainable Development Funds, Protection and conservation of species, conservation of renewable resources, implementation of NEQS, establishment of Environmental Tribunals and appointment of Environmental Magistrates, Initial Environmental Examination (IEE), and Environmental Impact Assessment (EIA).

Pakistan's Environmental Policy is based on participatory approach to achieving objectives of sustainable development through legally, administratively and technically sound institutions. The Federal Environment Ministry was established in Pakistan in 1975 as follow up a Stockholm declaration of 1972. The Ministry was responsible for promulgation of the environmental Protection Ordinance of Pakistan in 1983. It was the first comprehensive legislation prepared in the country. The main objective of Ordinance 1983 was to establish institutions i.e., to establish Federal and Provincial Environmental Protection Agencies and Pakistan Environmental Protection Council (PEPC). In 1993, Environmental Quality Standards (NEQS) were designed. The Act is broadly applicable to air, water, soil and noise pollution, as well as the handling of hazardous waste. Penalties have been prescribed for those who contravene the provisions of the Act. The powers of the Federal and Provincial Environmental Protection Agencies (EPAs) were also considerably enhanced under this legislation and they have been given the power to conduct inquiries into possible breaches of environmental laws either of their own accord, or upon the registration of a complaint.

2.6 SINDH ENVIRONMENT PROTECTION ACT 2014

The Sindh Environmental Protection Act was notified by the Provincial Assembly of Sindh via notification no. PAS/Legis-B-06/2014 dated March 20, 2014. The Act extends to whole of the province of Sindh and is to provide for the protection, conservation, rehabilitation and improvement of the environment, for the prevention and control of pollution, and promotion of sustainable development.



Under Section 2(xxxl), the Act defines "pollution" as the contamination of air, land or water by the discharge or emission of effluent or wastes or air pollutants or noise or other matter which either directly or indirectly or in combination with other discharges or substances alters unfavorably the chemical, physical, biological, radiation, thermal or radiological or aesthetic properties of the air, land or water or which may, or is likely to make the air, land or water unclean, noxious or impure or injurious, disagreeable or detrimental to the health, safety, welfare or property of persons or harmful to biodiversity.

The Act, under Section 17, empowers the EPA Sindh to acquire from the proponent an EIA/IEE assessment document of any project prior to commencement of any construction or operation activities. Section 19, empowers the EPA Sindh to acquire from the proponent an EMP of any project or activity so as to acquire comprehensive appraisal of the environmental aspects of that project or activity, mentioned in Sindh Environmental Protection Act 2014

Pakistan EPA Review of IEE and EIA Regulations- 2000

The Pakistan Environmental Protection Agency Review of IEE and EIA Regulations provide the necessary details on preparation, submission and review of the IEE and EIA. Categorization of projects for IEE or EIA is one of the main components of the Regulation. Projects are classified on the basis of expected degree of adverse environmental impacts. Project types listed in Schedule - II are designated as potentially less adverse effects. Schedule- I projects require an IEE to be conducted, rather than a full-fledged EIA, provided they are not located in environmentally sensitive areas.

Salient features of the regulations relevant to the proposed project are listed below:

Categories of projects requiring IEE and EIA are issued through two schedules attached with the Regulations. Oil and gas extraction projects including exploration, production, gathering systems, separation, and storage are included in an IEE category.

- The IEE / EIA must be prepared, to the extent practicable, in accordance with the Pak-EPA environmental Guidelines discussed in the sections to follow.
- A fee, depending on the cost of the project has been imposed for review of the IEE and EIA.



- The submitted report is to be accompanied by an application in prescribed format included as Schedule – IV of the Regulation.
- The EPA is bound to conduct a scrutiny and reply within 10-days of submittal of report (a) confirming completeness (b) asking for additional information, or (c) requiring additional studies.
- The EPA is required to make every effort to complete the review process for the IEE within 45-days, and of the EIA within 90-days, of issue of confirmation of completeness.

When EPA accords their approval subject to certain conditions, the following procedure will be followed:

- Before commencing construction of the project, the proponent is required to submit an undertaking accepting the conditions.
- Before commencing operation of the project, the proponent is required to obtain from the EPA a written confirmation of compliance with the approval conditions and requirements of the IEE/ EIA.
- There is a requirement for an EMP to be submitted with the request for obtaining confirmation of compliance.
- The EPA is required to issue confirmation of compliance within 15-days or receipt of request and complete documentation.
- The IEE / EIA approval will be valid for three years from date of accord.
- A monitoring report is required to be submitted to the EPA after the completion of construction followed by annual monitoring reports during operations.

2.7 THE SINDH EPA REVIEW OF IEE AND EIA REGULATIONS 2014

In exercise of the powers conferred by Section 37 of the Sindh Environmental Protection Act, 2014, the Sindh Environmental Protection Agency, with the approval of Government of Sindh has notified the 'Sindh Environmental Protection Agency (Review of Initial Environmental Examination and Environmental Impact Assessment) Regulations, 2014' vide notification No. EPA/TECH/739/2014 dated 16th December 2014.



This regulation describes the procedure for conducting environmental assessments and their approval process. Categories for projects requiring IEE, EIA or Environmental Checklists is mentioned in the regulation. The environmental assessment includes preparation of an Environmental Management Plan (EMP). SEPA Review of IEE/EIA regulations 2014 is attached for ready reference and further guidance.

Other Relevant Laws

National Resettlement Policy and Ordinance

At present, the only legislation relating to land acquisition and compensation is the Land Acquisition Act (LAA) of 1894. The LAA is, however, limited to a cash compensation policy for the acquisition of land and built-up property, and damage to other assets, such as crops, trees, and infrastructure. The LAA does not consider the rehabilitation and resettlement of disrupted population and the restoration of their livelihoods.

The Asian Development Bank (ADB) came forward and provided financial and technical assistance to the GoP in 1999. The MoE and Urban Affairs then engaged consultants who prepared the Draft National Policy which still is in the draft form and has not yet passed cabinet approval.

Land Acquisition Act, 1894

The 1894 Land Acquisition Act (LAA) with its successive amendments is the main law regulating land acquisition for public purpose in Pakistan. The LAA has been variously interpreted by local governments, and some province has augmented the LAA by issuing provincial legislations. The LAA and its Implementation Rules require that following an impacts assessment/valuation effort, land and crops are compensated in cash at market rate to titled landowners and registered land tenants/users, respectively.

The LAA mandates that land valuation is to be based on the latest 3-5 years average registered land sale rates, though, in several recent cases the median rate over the past year, or even the current rates, have been applied. Due to widespread land



under-valuation by the Revenue Department, current market rates are now frequently used with an added 15 per cent Compulsory Acquisition Surcharge as provided in the LAA.

- (1) Based on the LAA, only legal owners and tenants registered with the Land Revenue Department or possessing formal lease agreements are eligible for compensation or livelihood support.
- (2) It is also noted that the LAA does not automatically mandate for specific rehabilitation / assistance provisions benefiting the poor, vulnerable groups, or severely affected PAPs, nor it automatically provides for rehabilitation of income/livelihood losses or resettlement costs. This however it is often done in many projects in form of ad hoc arrangements based on negotiations between a specific Environmental Approval (EA) and the PAPs.
- (3) Exceptions to the rule are intrinsic to the fact that the law is elastic and are broadly interpreted at provincial level depending on operational requirements, local needs, and socio-economic circumstances. Recourse is often taken to ad hoc arrangements, agreements and understandings for resettlement in difficult situations. The above is also influenced by the fact that an amendment of the LAA has been considered necessary by the Ministry of Environment. Accordingly, a National Resettlement Policy (NRP) and a Resettlement Ordinance have been drafted to broaden LAA provisions and current practices so as to widen the scope of eligibility and tightening up loopholes (i.e. regarding definitions of malpractices, cut-off dates, political influence on routing, etc.). But both these documents are still awaiting government's approval for implementation.

The Act would apply for all the situations during the project when land area for the purpose of the project is needed to be acquired.

Affected Person Ordinance 2001

This Ordinance was promulgated in 2001 by the federal government to provide relief to persons or households affected by any Project due to loss of land or displacement. The Project under review is not affected by the provisions of this law as no displacement of population is expected to occur.



Biodiversity Action Plan

The key to protection of the biological heritage of Pakistan lies in the involvement of local people and in the support provided by competent institutions for conservation and sustainable use. The Government of Pakistan has recognized the importance of these measures in the preparation of the National Conservation Strategy and in becoming a signatory to, and ratifying, the Convention on Biological Diversity (CBD) in 1994. Developing the Biodiversity Action Plan for Pakistan, 2000 has been the most significant direct steps towards addressing the biodiversity loss.

The BAP recognizes that an EIA is used as a tool at a project level to identify environmental effects of a proposed project and to plan for reducing adverse effects. The BAP further stipulates that an EIA needs to be initiated at an early stage of project development and that public participation in the review of potential effects is important.

Canal and Drainage Act, 1873

The Canal and Drainage Act (1873) prohibits corruption or fouling of water in canals (defined to include channels, tube wells, reservoirs and watercourses), or obstruction of drainage. This Act will be applicable to the construction and O&M works to be carried out during the proposed Project.

The Sindh Irrigation Act 1879

This Act empowers the GoS to use the natural sources of water such as lakes, rivers, and streams, for supply of water for irrigation and other purposes. It allows the government to develop the required infrastructure, for example, canals, channels, pipelines, for the supply of water. It also allows the government to charge fee for the supply of water and regulate the water supply. The Irrigation Department of the Government of Sindh is the concerned department to which the project proponents have to apply to seek permit to obtain water from Indus River. The irrigation department will also charge fee as per the prevalent rates.

Employment of child Act, 1991



Article 11 (3) of the Constitution of Pakistan prohibits employment of children below the age of 14 years in any factory, mines or any other hazardous employment. In accordance with this Article, the Employment of Child Act (ECA) 1991 disallows child labor in the country. The ECA defines a child to mean a person who has not completed his/her fourteenth year of age. The ECA states that no child shall be employed or permitted to work in any of the occupations set forth in the ECA (such as transport sector, railways, construction, and ports) or in any workshop wherein any of the processes defined in the Act is carried out. The processes defined in the Act include carpet weaving, bidi (kind of a cigarette) making, cement manufacturing, textile, construction and others. SSGCL and its contractors will be bound by the ECA to disallow any child labor at the Project sites or campsites.

Cutting of Trees Act, 1975 & Protection of Trees & Bush Wood Act, 1949

The Cutting of Trees Act prohibits cutting or chopping of trees without prior permission of the Forest Department. Section 3 of this Act states "No person shall, without the prior written approval of the local formation commander or an officer authorized by him in this behalf, cut fell or damage or cause to cut, fell or damage any tree."

Similarly, the Protection of Trees and Bush wood Act, 1949 prohibits cutting of trees and bush wood without permission of the Forest Department. The Act was enforced to prevent unlawful removal / clearing of trees and green areas for any reason without the consent of the Forest Department.

Sindh Wildlife Protection Ordinance, 1972

The Sindh Wildlife Protection Ordinance was approved in pursuance of the Martial Law Proclamation of 25th March, 1969. Under this Ordinance, three types of protected areas viz. National Park, Wildlife Sanctuary and Game Reserve have been notified for protection, conservation, preservation and management of wildlife.



This law declares any such area and its wildlife the sole property of the Government, making it accessible only to public for recreation, education and research. No hunting, shooting, trapping or killing is allowed without obtaining a special permit to do so within specific conditions and time limitations.

Antiquities Act, 1975

The Antiquities Act relates to the protection, preservation and conservation of archaeological/historical sites and monuments.

The Sindh Cultural Heritage (Preservation) Act, 1994

This provincial Act empowers the Government of Sindh (GoS) to preserve and protect any premises or objects of archaeological, architectural, historical, cultural, or national interest in Sindh by declaring them protected.

Among various provisions of this act some are, formation of an Advisory Committee to government to overlook and subsequent right of Acquisition of a protected heritage of architectural, historical, archaeological or national value, custodian/guardianship rights for preservation and declaration of protected heritage, evaluation of ownership rights, take legal action against any offender who attempts to damage, destroy, remove, deface, alter or imperil the protected heritage or to build on or near the site. It also details the purchase, maintenance and repair works of a protected heritage under the government's jurisdiction. The advisory committee may also receive voluntary donations towards the cost of maintenance of a protected heritage site. The act also establishes the right of access to certain protected heritage sites, penalties for violators, formulation of rules and provides protection to the persons working under this Act.

Sindh Local Government Ordinances, 2001

These ordinances issued following the devolution process, establish regulations for land use, the conservation of natural vegetation, air, water, and land pollution, the disposal of solid waste and wastewater effluents as well as matters related to public health and safety.



Forest Act, 1927

This Act provides rules and regulations for the protection of forests, control of timber and other forest-produce transit, village forest and social forestry. The Act is being revised as the law was framed for regulating forests all over India. It was adopted as it is after the creation of Pakistan and it continues to remain in force till to date without assessing whether it fulfills present day's requirements or not.

This act has been comprehensively formed and specifies concerned agency the power to declare protected and reserved forests by government notification, powers entitled to forest settlement officers, power to acquire land over which right was claimed, powers to stop ways and water-courses in reserved forests, healing of claims relating to shifting cultivation, power to issue and publish notification to reserve trees, power to make rules for protected forests, power to declare forest no longer reserved, order on rights of pasture or transit forest-produce, record keeping by the forest settlement officer, commutation of right to appeal, time limit for resolution of claims and appeals, notification of acts prohibited in such forests (unlawful cutting of trees), awarding penalties on violations.

National Forest Policy, 2001

The National Forest Policy deals with the Renewable Natural Resources (RNR) of Pakistan such as forests, watersheds, rangelands, wildlife, biodiversity and their habitats with the aim to eliminate the causes of depletion to such resources through the active participation of various concerned stakeholders and government departments.

Some of the main elements of this policy include reducing the impact of socio-economic causes such as population planning, providing substitutes to firewood, poverty alleviation, reducing political interference in the forest and wildlife departments, renovating and invigorating institutions of RNR (local governments i.e. districts), policies for fragile eco-systems (mountain forests, mangroves), development of rain forests, maintaining irrigated plantations, preservation of unique forests, protection of wildlife, rangelands and desert eco-systems, planting of trees and fodders on farmlands and general monitoring and evaluation schemes.

2.8 NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA) ACT 1997

The NEPRA Act was approved by Parliament and signed into law in December 1997. It seeks to create an autonomous, independent regulatory authority, which will be solely responsible for the power sector. It will be responsible for the oversight of the power sector and will exercise control through its power to license power generation, transmission and distribution. It will regulate tariffs for all these activities. It will perform its functions through transparent processes to be enshrined in rules that are being framed in a transparent manner through appropriate rules.

Power Policy 1998

The revised power policy was implemented in 1998. The objective and intentions of the Government of Pakistan (GOP) to new policy is to move towards the creation of a competitive power market in Pakistan. It proposes to do so by restructuring and privatizing the existing thermal power generation, the power transmission and distribution functions and assets of existing public sector utilities (WAPDA/K-Electric), by the creation of a fully autonomous regulatory authority, the National Electric Power Regulatory Authority (NEPRA), and through its future IPP policy. The salient features of the Policy are;

- The basis for selection of private power project will be minimum levelized tariff through International Competitive Bidding. Variable tariffs over the life of the project will be permitted under terms specified prior to bidding. The process of selection will involve pre-qualification, issuance of a Request for Reports (RFP), bidding and evaluation of bids against bid criteria clearly laid out in the RFP.
- It is recognized that without a proper feasibility study for a particular site specific hydel or indigenous coal based project, it will not be possible to invite competitive bids and receive firm offers. Thus, detailed feasibility studies for such projects will be prepared before bids are invited.
- Hydel projects will be implemented on a BuildOwnOperateTransfer (BOOT) basis; to be transferred to the province in which it is situated at the end of the concession period, and thermal projects on a BuildOwnOperate (BOO) basis.



- Competitive Tariffs will comprise an Energy Purchase price and a Capacity Purchase Price with adequate provisions for escalation.

2.9 INTERNATIONAL GUIDELINES AND TREATIES/CONVENTIONS

World Bank Guidelines on Environment

The principal World Bank publications that contain environmental guidelines are listed below.

- Environmental Assessment–Operational Policy 4.01. Washington, DC, USA. World Bank 1999
- Pollution Prevention and Abatement Handbook: Towards Cleaner Production, Environment Department, the World Bank, United Nations Industrial Development Organization and the United Nations Environment Program, 1998
- Environmental Assessment Sourcebook, Volume I: Policies, Procedures, and Cross- Sectoral Issues. World Bank Technical Paper Number 139, Environment Department, the World Bank, 1991
- Environmental Assessment Sourcebook, Volume III: Guidelines for Environmental Assessment of Energy and Industry Projects. World Bank Technical Paper No. 154, Environment Department, the World Bank, 1991

The first two publications listed here provide general guidelines for the conduct of an EIA, and address the EIA practitioners themselves as well as project designers. While the Sourcebook in particular has been designed for the Bank projects, and is especially relevant for the impact assessment of large-scale infrastructure projects, it contains enormous information which is useful to environmentalists and project proponents.

International Convention on Biodiversity

The International Convention on biodiversity was adopted during the Earth Summit of 1992 at Rio de Janeiro. The Convention requires parties to develop national plans for the conservation and sustainable use of biodiversity and to integrate these plans into national development programs and policies. Parties are also required to identify components of



biodiversity that are important for conservation, and to develop systems to monitor the use of such components with a view to promoting their sustainable use.

Environment Related Relevant International Agreements in Pakistan's context

Pakistan is a party to the following treaties and agreements in furtherance of its environmental goals and programme.

Treaty	Pakistan Status
Convention on the Protection of Ozone Layer on Dec 18, 1992	Signed
The Amendment to Montreal Protocol on Substance that Depleting Ozone layer	Signed
UN Framework Convention on Climate Change on June 13, 1992	Signed
Convention on the Continental Shelf on October 31, 1958	Signed
The Convention on High Seas on October 31, 1958	Signed
The UN Convention on Law of the Sea on December 10, 1982	Signed
The Convention on Territorial Sea and the Contiguous Zone and the Agreement for the establishment of Network of Aquaculture Centers in Asia and the Pacific	Signed
The Convention on Wetlands of the International Importance on July 23, 1976	Signed
The Convention on protection of the World Cultural and Natural Heritage on July 23, 1976	Signed
The Convention on International Trade in Endangers Spice of Wild Fauna and Flora	Signed
The Convention on Conservation of Migratory Species of Wild Animal on Dec 01, 1987	Signed
The Convention on Biological Diversity in 1994 and became party to the CBD, Convention duly recognizes the intrinsic value of biological diversity, genetic, social, economic, cultural,	Signed



educationist, recreational and esthetic values of biodiversity and its components	
The International Plant Protection Convention.	Signed
The Plant Protection Agreement for Area & pacific region	Signed
The Agreement for the establishment of a convention for controlling the desert lost in eastern region of its Distribution Area in South East Asia	Signed
The Treaty Banning Nuclear Weapon Test in the Atmosphere, in Outer Space and under Water on March 3, 1988	Signed
The International Convention on Oil Pollution Preparedness Response and Corporation	Signed
The Convention on prohibition of Military or any other Hostile Use of Environmental Modification Techniques and Accession of Feb 27, 1986	Signed
Pakistan became a party to Montreal Protocol by Ratifying the protocol and its London amendment on Dec 18, 1982.the subsequent amendments known as Copenhagen Amendment which, accelerate the phase out for rectified in Jan 1995.	Signed
Convention of Intemational trade Endangerous Species (CITS)	Signed
World heritage Convention Ramsar Convention	Signed
United Nation Convention to Combat Ozone Depletion (CCD). The convention signed and ratified in 1996	Signed
Stockholm Convention for Phasing out Parenting Organic pollutants (POPs) in 2001	Signed



Applicable International Environmental and Occupational Safety and Health Laws and Regulations

International and National Non-Governmental Organizations

International and National Non-Government Organizations (NGOs), such as the International Union for Conservation of Nature and Natural Resources (IUCN) and the World Wide Fund for Nature (WWF), have been active in Pakistan for some time. Both of these NGOs have worked closely with the Governments at the Federal as well as Provincial levels and have positively contributed to the cause of environment. They have played significant role with regard to the formulation of environmental and conservation policies. And last but not the least, another the most prominent NGO namely "Sustainable Development Policy Institute" (SDPI) has also played very significant role in upholding the cause of environmental protection in Pakistan. Environmental NGOs have been particularly active in the advocacy for promoting sustainable development approaches. Most of the government's environmental and conservation policies, even at the provincial and federal levels, have been formulated in consultation with these leading NGOs, who have also been involved in drafting new legislation on conservation.



DESCRIPTION OF THE ENVIRONMENT

3.1 INTRODUCTION

This document describes the scope of the study plan for comprehensive characterization of baseline environmental and social conditions existing in and around factory.

Environmental baseline survey presents the existing environmental scenario and the results from the assessment and evaluation aspects emerging during the operation of the factory. Screening of potential environmental aspects, the assessed and evaluated impacts requiring necessary mitigation measures are suggested in the report. On the basis of the findings, programs of environmental improvement is suggested and followed by training and campaigning in order to enhance awareness and care at all levels of personnel. Procedures are documented to direct the implementation of the programs in the field.

Specific Objectives

By implementing an Environmental Management System (EMS) in accordance with the PEPA Standards, the objectives include:

- To define, describe and characterize the existing baseline conditions to ensure that this study will provide a sound technical bases for ongoing evaluation of environmental effects during operations
- To identify the methods and approach for data gathering and analysis for reviews of others
- To identify the specific potential impact of each step of the process

Secondary Objectives

- Reducing environmental liability and risk,
- Helping to maintain consistent compliance with legislative and regulatory requirements,

- Preventing pollution and reducing waste,
- Pollution-incident coverage is issued,
- Identifying areas for reduction in energy and other resource consumption, and
- demonstrating commitment to high quality

3.2 DESCRIPTION OF ENVIRONMENTAL BASELINE

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.

Background

Shaheed Benazirabad district was formerly known as Nawabshah district. It was renamed in April 2008 after the assassination of Benazir Bhutto (a reputed national political leader and Chairperson of Pakistan People's Party).

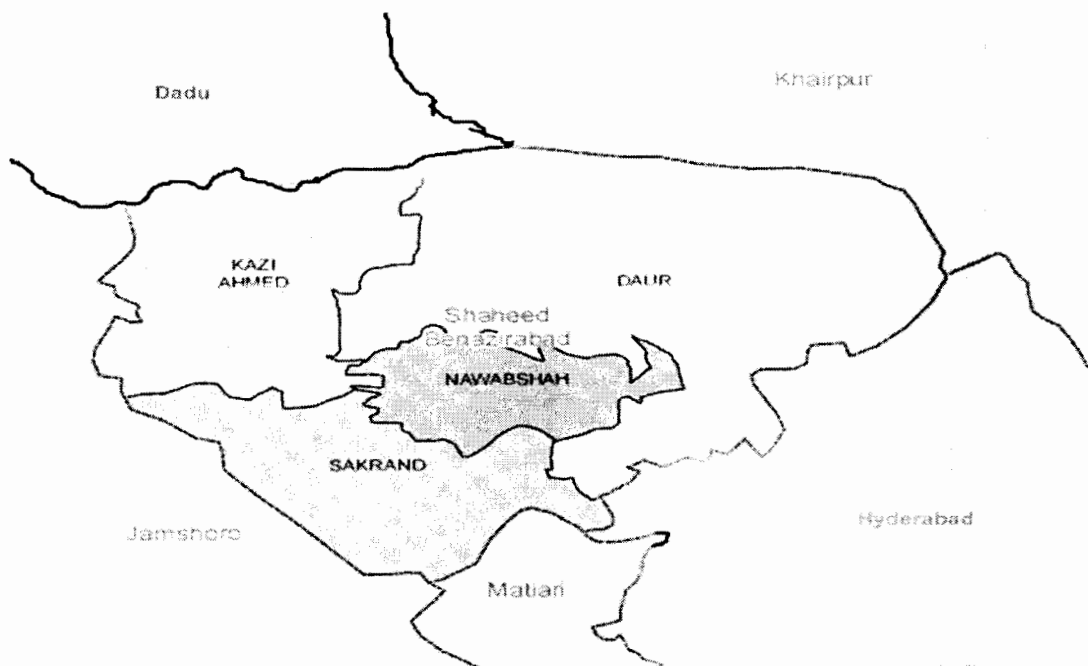


Fig 3.1: Map of District Shaheed Benazirababd



District at a Glance

Area	4,502 Sq. Kms.
Population - 1998	1,071,533 persons
Male	555,677 (51.86 %)
Female	515,856 (48.14 %)
Sex Ratio (males per 100 females)	107.7
Population Density	238 per Sq. Km
Urban Population	282,359 (26.35 %)
Rural Population	789,174 (83.19 %)
Average Household Size	6.0
Literacy Rate for 2010-11	(10 +) 46 %
Male	65 %
Female	25 %
Population - 1981	812,534 persons
Average Annual Growth Rate (1981 - 98)	1.63 %
Total Housing Units (1998)	177,522
Pacca Housing Units	47,339 (26.67 %)
Housing Units having Electricity	134,053 (75.51 %)
Housing Units having Piped Water	41,835 (23.57 %)
Housing Units using Gas for Cooking	23,197 (13.07 %)

3.3 ADMINISTRATIVE DIVISION



District Shaheed Benazirabad has its district headquarters in Nawabshah city. This district has four talukas named Nawabshah, Sakrand, Kazi Ahmad and Daur. It has 51 union councils and 321 mouzas (revenue village). Out of the total mouzas, 291 are rural mouzas, 10 are urban, 14 are partly urban, 4 are forests and two mouzas are un-populated.

Table 3.1: Administrative Division of District Shaheed Benazirabad

Benazirabad	Kanungo circle/ Supervis ory Tapas	Patwar Circles/ T apas	Number of Mouzas					
			Total	Rural	Urban	Partly Urban	Forest	Un-po- pulated
S. Benazirabad District	8	91	321	291	10	14	4	2
Nawabshah Taluka	1	13	51	44	3	4	--	--
Sakrand Taluka	2	18	63	57	1	1	3	1
Kazi Ahmed Taluka	3	27	64	56	2	4	1	1
Daur Taluka	2	33	143	134	4	5	--	--

3.4 SOCIO – CULTURE ENVIRONMENT

Culture (Ethnicity, Religion and Politics)

Shaheed Benazirabad has a rich traditional Sindhi culture. Women usually wear Shalwar Qameez but quite often wear the traditional dress as well i.e. Ghaghra or Parro. Traditionally, women wear bangles. Men usually wear a Shalwar Qameez distinguished by broader bottoms, and a traditional Sindhi style cap.

In addition to the Sindhi ethnic group, Punjabi, Urdu speaking migrants (muhajirs) and Baloch tribes are also residing in this district. Sindhi and Urdu are the major languages of the district. Urdu is widely spoken in urban areas where Urdu speaking population constitutes 30% of the total population. Punjabi and Balochi are also prominent languages of this district. Islam is

the major religion of this district representing 96.5% of the population. Hinduism is the religion of minority, representing 2.8% of the population. Christians and Ahmadis are also minority religious communities in this district

Main Sources of Livelihood/Income

The sources of employment are less diversified in this district. The sources of employment in the urban areas include: small business, services, agriculture extension services, private jobs, government jobs and overseas employment but in the rural parts of this district, agriculture sector remains dominant among all the sectors.

The following table shows the number of mouzas reporting sources of employment in district Shaheed Benazirabad. Majority of the male population is associated with agriculture (in 81% of rural mouzas) followed by labor (in 12% of rural mouzas). While in the category of some, services sector, personal business and labor are most frequent in male population. However, the female participation is negligible in agriculture as only 10% of the mouzas have reported females' involvement in agriculture sector. In the category of some, female participation can be seen in services, agriculture, personal business and casual labor

Table 3.2: Number of Mouzas Reporting Sources of Employment

Gender	Quantification	Service	Agriculture	Trade	Industry	Personal business	Labour
Male	MOSTLY	3	250	29	----	2	37
	SOME	229	26	276	7	25	187
	NONE	73	29	---	298	278	81
Female	MOSTLY	--	86	---	1	---	64
	SOME	63	95	3	2	2	153
	NONE	242	124	302	302	303	88

The categories under which these mouzas have reported against different livelihood sources are:

- Mostly: population of 50 percent and above

- Some: population between 1 percent and 50 percent
- None: less than or equal to 1 percent

3.5 DEMOGRAPHY

In Pakistan, male population is more than the female population and is among those four countries where life expectancy for females, at birth, is less than that of males. Sex ratio in district Shaheed Benazirabad is 108 male per 100 females, which is more than the ratio at the National level that is 106.

Though there could be other possible reasons for such a difference in male to female ratio, one probable reason of this ratio could be underreporting of females during national surveys. Besides, a very high maternal mortality rate and poor health care at the district and provincial level are likely to be instrumental for this difference. District Shaheed Benazirabad, like majority of the other districts in Sindh, is rural by its characteristics. 74 percent of the population resides in rural area as compared to the 26 percent that resides in the urban areas.

Table 3.3: Population Details by Taluka

Taluka	Population	Population	Female	Pop Density	Sex Ratio	Average HH Size	Estimated HH
Daur	399,904	207,382.83	192,521	176	108	6.4	62,485
Kazi Ahmed	284,775	147,679.18	137,096	268	108	5.6	50,853
Nawabshah	396,018	205,367.48	190,650	843	108	6.4	61,878
Sakrand	314,574	163,132.34	151,442	362	108	5.6	56,174
Total	1,395,272	723,562	671,710	299	108	6.0	231,390

Source: Estimated using Table 1 of Census 1998

Table 3.4: Population Size and Growth of District Shaheed Benazirabad



Total Population	1135131	-----
Urban Population	313600	27.70 %
Rural Population	821531	72.80 %
Male	599275	52.79 %
Female	535856	47.20 %
Area	4239.4	Per sq K.M
Population Density	240	Per sq K.M
Growth Rate	3.09 %	-----
Total Fertility Rate (TFR)	5.40 %	-----

Table 3.5: Broad Age Groups (% Distribution)

Below 15 Years	45 %
Between 15-64 Years	52.2 %
Over 65 Years	2.8 %
Singulate Mean age at Marriage of Female	20.6 %
% of Females age 15-49 in total Population	22.6 %
% of Married Females in Total Female Population	68.9 %

Health

The government healthcare facilities in the comprises comprise Teaching Hospitals, Headquarter Hospitals, Tehsil Headquarter Hospitals/Civil Hospitals, Rural Health Centers, Basic Health Units, Dispensaries, Mother and Child Health Centers, and 15 Sub-health Centers, in addition, a large number of private healthcare facilities.

Solid Waste Management



The solid waste management facilities are not up to the mark in this district. Only Nawabshah city has proper waste management facility. The daily waste generation of this city is 87,989 kg. Tractor-trolleys are used for waste disposal. Currently there are four such trolleys to collect the solid waste. The collection efficiency of these vehicles is 75% in the city of Nawabshah. Like any other district of Pakistan, in the rural areas of this district, no solid waste management facility is available. Furthermore, the non-availability of data for other talukas and rural area are also a hindrance in the assessment of solid waste management of this district.

3.6 PHYSICAL ENVIRONMENT

Geography

The district lies in $67^{\circ} 52''$ to $68^{\circ} 27'' 2'$ east longitudes to $25^{\circ} 59''$ to $26^{\circ} 38'' 5'$ north latitudes. The district is bounded by district Khairpur and Saanghar on the east, district Jamshoro on the west, district Khairpur and Naushehro Feroze on the north and district Matiari on the south.

This district is located in the center of the Sindh province of Pakistan, and is therefore commonly known as the heart of Sindh. Indus River flows on the left bank of the district. Total geographical area of the district is 451,000 hectares³. The land structure of this district can be divided into three parts. First, on the northern side of the district is the kacha (the lands alongside the Indus River), these lands are very fertile but are prone to riverine floods. Second, the central and major part of the district comprises of the irrigated cultivable lands. This area consists of very productive agricultural land. Third, the eastern part of the district that comprises of the barren desert lands in Daur taluka.

Geology and Geomorphology of Nawabshah

The project area is typically flat and there are no hills or mountains in the area. The geological history of the project area follows from the formation of the Himalayan mountain range and the simultaneous formation of a depression between the peninsula and the mountain. Over the centuries, this depression has been filled with sediments from the river Indus and its tributaries giving rise to a vast alluvial plain called the Indus plain. The plain is bordered by the mountains of Baluchistan to



the west and the sandy hills of the Thar Desert to the east. The alluvial sediments are underlain by the Nabisar formation sandstone and mudstones of the Manchar formation followed by the Ecocene limestone formation.

The Ecocene limestone underlies the entire lower Indus plain. It was deposited in a shallow Sea, a remnant of the ancient Tethys sea that finally disappeared as a result of the gradual merging of the Indian Plate into the Eurasian plate and the subsequent formation of the Himalayan mountain range various geomorphologic units exist in the Indus plain that correspond to the different depositional patterns over the period of time and include the meander plains, the flood plains etc.

Climate

The highest temperatures each year in Pakistan, typically rising to above 48 °C (118 °F), are usually recorded in Shaheed Benazirabad District and Sibbi from May to August. The climate is generally dry and hot, but sometimes the temperature falls to 0 °C (32 °F); on rare occasions (once every 25 years or so) it has fallen to below -7 °C (19 °F) in December or January

Frosts are rare south of Nawabshah. Rainfall is sparse and erratic but most likely in July-August. The average annual rainfall decreases northwards from about 175mm to 125mm. Evaporation rates vary from 11mm/day in the hottest months to 3mm/day in the winter, totaling 2250-2350mm/year. Without irrigation, there can be no sustained agriculture.

Table 3.6: There exist several meteorological stations in Sindh data recorded at same of these stations

Climate Data of Nawabshah											
Year	T	TM	Tm	PP	V	RA	SN	TS	FG	TN	GR
2006	26.6	36.0	18.2	304.54	9.4	14	0	19	0	0	0
2007	27.3	37.0	19.0	126.50	10.1	8	0	1	3	0	0
2008	26.7	36.5	18.6	175.7	10.0	13	0	12	4.5	0	0
2009	27.4	36.3	18.9	232.66	9.9	18	0	23	7	0	0
2010	27.2	36.0	17.4	250.20	9.4	18	0	27	2	0	2
2011	27.0	35.9	16.5	129.29	9.8	12	0	7	0	0	0



2012	27.3	36.1	18.9	73.16	8.1	13	0	9	11	0	0
2013	27.8	36.4	18.3	374.15	7.7	17	0	8	8	0	0

Source: Weather station: 417490 (OPNH) Latitude: 26.25 Longitude: 68.36 Altitude: 37

Interpretation average annual climate values

- T:** Annual average temperature (°C)
- TM:** Annual average maximum temperature (°C)
- Tm:** Annual average minimum temperature (°C)
- PP:** Total annual precipitation of rain and / or snow (mm)
- V:** Annual average wind speed (Km/h)
- RA:** Total days with rain during the year
- SN:** Total days with snow during the year
- TS:** Total days with thunderstorm during the year
- FG:** Total days with fog during the year
- TN:** Total days with tornado or funnel cloud during the year
- GR:** Total days with hail during the year

3.7 TOPOGRAPHY

Topography of Sindh can be divided into four district parts topographically i.e. Kirthar range on the west; a central alluvial plain bisect by the Indus river in the middle, a desert belt in the east and the Indus delta in the south.

Kirthar Range

Kirthar range consists of three parallel tiers of ridges which run in north south direction and vary in width from 20 to 50 km.

The kirthar range has little soil and is mostly dry and barren.

Central alluvial plain



It consist the valley of the Indus River; this plain is about 580 km long and 51,800 sq. km in area and gradually slopes downward from north to south. It is a vast plain, around in meters high above sea level. According to the past tradition it has been divided into three distinct zones.

- Lar of Southern Sindh comprising the areas of south Hyderabad.
- Which alo or central Sindh, the area lying immediately around Hyderabad.
- Siro or Northern Sindh comprising the area beyond Noushero Feroz and Sehwan
- Eastern desert belt including low duns and flats in the north. The Achhroothar white sand desert, to the south and Thar Desert in the south east. There is small hill troat known as Thar hills. The aravalli series belong to Archaan system which constitutes the oldest rocks of the East crust.

Indus delta

It consisting of the distributes of the Indus river which starts operating out near Thatta areas, the delta i.e. flood plain in the sec. the river surface is marked by a network of flowing and abandoned channels. A coastal strip 10 to 40 Km wide is flooded at high tide and contains some mangrove swamps. The overall project area is also in the same central alluvial plain which is the main irrigated area of the Soil.

The Riverine forests of Nawabshah division group in narrow belts along the bank of Indus. They cover an area of 440,491.214 acres which vary from 4 to 6 km in width and a line barrier between the river and the embankments has been formed against the flood in the country side. Reverine forest of Nawabshah District have been significant sanctuaries for a variety of mammals and reptiles especially Hog deer and other animals like Partridges, wild boars, tackles, sand grouse, wolves, porcupines etc. the main species of plants of the area are Acacia Nilotiea, prosopisspicigera, prosopsglandulosa, tamarixdioica, desmastachyabipinnala, colotropisproceraete.

Soil



The soil in the plains of Sindh is plastic clay that has been deposited by the Indus combined with water, it develops into a rich mould and without water it degenerates into desert. Nearly the entire Indus valley has soil which is extremely friable and easily disintegrated by the flow of water. Resultantly the water always contains a large amount of suspended silt.

Soils of the project area are of recent alluvial origin being pedologically immature and without develop weathering characteristics. The uppermost layers are relatively young and their physical properties reflect their mode of deposition. Textures are closely related to depositional conditions and all mapping based on geomorphics units. Most of the soils are silty loams and silty clay loams with in a complex textural stratification ranging from fine sandy loam to silty clay. All soils contain gypsum and calcium carbonate, land that is not cultivated is mainly highly saline and sodic. Non-saline sodic sols are rare, representing less than 2% of the area.

Agriculturally, the soils have ample quantities of exchangeable and available Ca, Mg, and K. N, P and organic matter contents of the soils are low and all crops (including legumes) usually respond to application of artificial fertilizer or animal manure.

Road Network Infrastructure

Geographically, district Shaheed Benazirabad is the center of Sindh province of Pakistan which makes it a major railways and road transportation hub in the province. By road, the district headquarters of Nawabshah is at a 4 hours' drive from the provincial capital Karachi. National highway (N5) passes through Sakrand and Kazi Ahmad talukas of this district. This district has a well-connected road network and has 349 kilometers of good quality roads in the entire district. District headquarters is connected with other talukas through metalled roads.

Irrigation system

The irrigation system of this district, due to the canal system, tube wells and rivers, is quite efficient. The lands on the bank of Indus River are very fertile. The canal system is mainly in the central part of the district; particularly Nusrat Canal is the

main irrigation facility in the central zone. As the table 1.1.2 shows, majority of the mouzas are irrigated with canals followed by the tube wells and river. Out of the 305 rural mouzas, 287 (94%) are irrigated with the help of canals and 194 (64%) are irrigated through tube wells

Table 3.7: Mouzas Reporting Sources of Irrigation

ADMINISTRATIVE UNIT	RURAL POPULATED MOUZAS	NUMBERS OF MOUZAS REPORTING SOURCE OF IRRIGATION							
		Canal	River	Tube well /well	Ravine	Spring /Stream Karez	Arid (Barani)	Flooding/ Torrent	
S. Benazirabad District	No.	305	287	22	194	4	--	4	13
	%	100	94	07	64	1		1	14
Nawabshah Taluka	No.	48	48	--	32	-	--	--	--
	%	100	100		67				
Sakrand Taluka	No.	58	49	--	51	2	--	1	--
	%	100	84		88	3		2	
Kazi Ahmad Taluka	No.	60	54	10	55	2	--	--	13
	%	100	90	17	92	3			12
Daur Taluka	No.	139	136	12	56	---	---	3	---
	%	100	98	09	40			2	

Agriculture

Agriculture sector plays significant role in the overall economic performance of Pakistan. Currently, this sector provides employment opportunities to 45% of the labor force in Pakistan and provides sources of livelihood to 60% of the population in the rural areas. Agriculture contributes 21% to Gross Domestic Product (GDP) of Pakistan¹. Nonetheless, available



literature shows that, for a sector to be productive and efficient, the gap between labor force participation and share of GDP should be minimum. The huge gap shows the low agriculture productivity and chronic poverty prevailing in the rural areas of Pakistan. Shaheed Benazirabad contributes significantly in agriculture sector of Sindh because its climate is suitable for production of various food items including the Kharif crops of maize, rice, sugarcane, cotton and bajra and Rabi crops of wheat, barley, Gram and barseen. In addition to these, fruit orchards are abundant in this district. Mouza statistics have reported that fruit orchards are widespread in 33% of the mouzas.

Total reported area of the district is 451,000 hectares, out of which 240,000 hectares (53%) are cultivated. Within the cultivated area, 168,000 hectares are net sown¹⁸ whereas 72,000 are currently fallow lands. The remaining 47% of the total reported area is un-cultivated; out of which 154,000 hectares are not available for cultivation and 6.8% of the area is cultivable waste.

Table 3.8: Cultivated and uncultivated area

Shaheed Benazirabad		
Reported Area		451
Cultivated / Cropped Area	Total	240
	Current Fallow	72
	Net Sown	168
	Area sown more than once	51
Un-cultivated Area	Total	212
	Culturable Waste	31
	Forest	27
	Not available for Cultivation	154

Table 3.9: Details of crops with regard to cultivation

Type	Crop	Area Sown in 2008- 09 (000 Hectares)	Production in 2008- 09 (000 Tonnes)	Area Sown in 2010- 11 (Acres) FAO
Food	Wheat	77.5	277.9	-
	Rice	3.8	12.7	6,761
Cash	Sugarcane	23.7	996.1	90,659
	Cotton	46.3	236.9	156,506

Industry

Shaheed Benazirabad has industries pertaining to the agriculture sector. Famous among these are the sugar mills in this district as sugarcane is cultivated on large scale in this district. In the census of manufacturing industries 2000-01, 27 industries were reported in this district with a total asset value of 2.3 billion rupees in that year. These industries reported a daily employment of 3,404 persons in 2000-01.

Livestock

Livestock sector maintains a unique position within the agriculture sector of Pakistan. It contributes 51% to the value addition in agriculture sector of Pakistan. It also contributes 9% to the GDP of Pakistan²³. Besides, this sector contributes to the foreign exchange earnings, dairy products' needs, food security and daily cash income of the people of Pakistan. It helps to reduce the income inequalities especially in case of emergencies (floods, crop failure). This sector is considered as most secure source of livelihood for small farmers and landless poor. The share of Sindh province in livestock population of Pakistan is 20%.

River Water Quality

The water quality of Indus River generally considered excellent for irrigation purpose. The total dissolved solid (TDS) ranges from 60mg/l in the upper reaches to 375 mg/l in the lower reaches of the Indus, which are reasonable levels for



irrigated agriculture and also as raw water for domestic use. The disposal of saline drainage from various irrigation projects has been a major factor in the increased TDS in the lower reaches of the river in the Indus Plan. There is progressive deterioration downstream and the salinity is at its maximum at the confluence of the Chenab and Ravi rivers, where the TDS ranges from 207 to 907 mg/l. A slight improvement in water quality is noted further downstream at Panjnand due to dilation from the inflow from Sutlej River. The quality of the Indus water and Guddu however is within acceptable limits for agriculture. TDS is being in the range of 164-270 mg/l. In the upper reaches of the Indus River the dissolve oxygen (DO) content remains above 8.5 mg/l which is well above acceptable levels of 4 mg/l. The BOD downstream of Attock has been recorded as 2.9 mg/l. At Kotri it has a suspended solid content of 10 to 20 mg/l. Indus river water quality has been studied at Dadu-Moro bridge and Kotri barrage, with nitrate levels 1.1 and 7.5 mg/l, Phosphate at 0.02 and 0.3 mg/l, BOD at 2.4 and 4.1 mg/l, facial Coliform at 50 to 400 per ml and Aluminum at 1.8 and 0.2 mg/l respectively. Due to industrial waste discharges from Punjab and Sindh a high contents of heavy metals such as Ni, Pb, Zn and Cd have been also found in Indus.

Lakes

There exist several fresh water and brackish lake in the Sindh province. The salient among those include Manchar, Keanjhar and Haleji lakes. In addition there exist a large number of small lakes and ponds in the irrigated areas of Sindh most of which have been created as a result of extensive irrigation and very shallow ground water.

Ground Water Source

The Indus basin was formed by alluvial deposits carried by the Indus and its Tributaries. It is underlain by an unconfined aquifer covering about 15 million acres 160,700 sq.km in surface area. In Sindh 28% of the area is underlain by fresh ground water. This is mostly used as supplemental irrigation water and pumped though tube well.

3.8 ARCHEOLOGY

The mausoleum of Thul Mir Rukun, a historical and archaeological tomb, is the property of the Archeology Department of the Government of Sindh and is situated 15 kilometres (9.3 mi) away from Daulatpur Taluka (Town). A road from Kazi



Ahmed Town leads to Thul Rukan, via Pabjo village, reaching this exemplary thousand year old archaeological construction. The tomb is 60 feet (18 m) high. Mr. Henry Cusin, the British Archaeologist writes in his book Sindh's Archeology (Sindhi Translation Sindh Ja Qadeem Aasaar by Ata Muhammad Bhambro) that the bricks used in the construction of this tomb were made and prepared during the Buddhist Rulers' period. The line painting of the birth of Gotama Buddha was shown on the bricks clearly, which are preserved and kept by the Sindh Archaeological Department. He writes that ornaments, small effigies, and statues were also found when the ground was excavated around the tomb.

Ecological Resources fisheries, aquatic biology, wildlife, forests, rare or endangered species

Fishery and Aquatic Biology:

There are no worth mentioning sources of fishery in the form of fresh water fishery or fishing ponds or else in the area of influence of the project. The nearest river is Ravi which hardly contains any fish and is quite distant from the project site is out of the influence of the said project. There is no water body worth reference where fish or aquatic life could be found. There is no fish or other worth mentioned aquatic life present in it.

Biodiversity:

Mainly a country's wilderness areas and scenic landscapes with their associated flora and fauna form natural capital of a country. Both collectively and within each level, the range or variety of the resources is referred to as the "Biological Diversity". The contribution of the "Natural capital" is recognized at three distinct levels including genera, species, and community habitat and ecosystem.

Pakistan comprises of a total of nine major ecological zones and the term has relevance for each of Pakistan's administrative units—district, province, and particularly country. The greater the number of genera, species and habitats and ecosystems present within these units, the greater is the Biodiversity. It is in this background that the biodiversity of the area is discussed below:



In the agricultural fields, the trees are raised along field boundaries, water courses, in linear fashion as shelterbelts or wind breaks and individual scattered trees. The main species growing as shelterbelts or wind breaks are Eucalyptus, Conocarpus, Neem and Agatagr andiflora (Manjadri)

Flora and Fauna of the Area

There are various trees growing along roads, opens spaces, otaques and open spaces for shade and aesthetic purpose. They include, Poinciana pulcherima (Gold Mohar), Albizzia procera (Siris), Melia azadirach (Bakain), Tamarindus Indica (Tamarind) and Pithecolobium dulce, (Jungle Jalebee) and Cassia fistula (chimkani)

Table 3.10: Flora of the Area

Ser No.	Botanical Name	English Name	Local Name
1	Acacia nilotica	Gum acacia	Baber
2	Albizzia procera	Indian walnut	Achosirhan
3	Azadirachta indica	Ash-leaved bead tree	Nim
4	Cassia fistula	Pudding pipe tree	Amaltas
5	Conocarpus lanceifolius	Ethiopian teak	Kono
6	Dalbergia sissoo	Shisham	Talee
7	Eucalyptus camaldulensis	Red-gum	Sufado
8	Ficus bengalensis	Ficus	Bur
9	Pithecolobium dulce	Jangle pithecolobium	Jungle Jalebee
10	Salvia molarbarica	Silk cotton tree	Simal
11	Sesbania aegyptica	Egyptian sesbania	Manjathri
12	Terminalia arjuna	Terminalia	Aarjan



13	Thespesiapopulnea	Tulip tree	Pyruspeepal
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Fauna

The present state of almost all wildlife species in this region is bleak. Most of the wildlife species are found in areas which are not suitable for human habitation and cultivation. Birds from the South Asian subcontinent, East Africa, Europe and much of Asia are found in the Sindh, which serves as a caravanserai for Eurasian avifauna travelers. Some fly in to stay for the winter, while the rest fly through. For many species the province serves as a breeding ground while others procreate in other areas but have been spotted in this region. There are resident species specific to Sindh, whilst others come from far and wide. Fauna reported from the area.

Table 3.11: Fauna

Sr. No	English Name	Scientific Name	Local Name
Mammals			
1.	Sindh Ibex/ Persian Wild Goat	Capra Aegagrus Blythi	Pahari Bakra
2.	Indian Wild Ass/ Gorkhar/ Onagar	Equus Hrmionus	Khar Jungli Billa
3.	Jungle Cat/ Swan Cat	Felas Chaus	Jungli Billi
4.	Honey Badger/ Ratel	Mellirooa Capensis	Bijjum Gor Pat
5.	Mouse like Hamster	Calomyscus Hotsoni Hamster	Chooa

Reptiles and Amphibians			
6.	Spotted Pond Turtle	Geoclemys Hamiltani	Talabi Katchwa
7.	Indian Sawback River Turtle	Kachugatecta	Daryai Katchwa
8.	Yellow Stripped Monitor Lizard	Varanas Flaresceus	Goh, Dhari Dar Goh



9.	Sindh Broad Tailed	Gecko Teratolepis Fasciata	Sindh Mot Dum Chhupkali
10.	Indian spiny Tailed Lizard	Uromastix Hardwcki	Sanda, Sandho
11.	Oxus/ Black Cobra	Naja Oxiane	Kala Nag, Cobra
12.	Indus Toad	Bafo Andersori	Khushki Ka Maindak
Birds			
13.	Black Farancolin/ Partoidge	Francolinus Francolinus	Kala Titar; Karo Titar
14.	Gray Farancolin/ Partoidge	Francolinus Pondicerianus	Bhura Titar; Achho Tittar
15.	Yellow legged Green Pigion	Treron Phocnicoptra	Harrial Kabutar
16.	Red Avadarat/ Red Munia	Amandar Formosu	Surkh PIDDI, Garrho Cheeho
17.	Rosy Starling/ Rosy Pastor	Sturnus Roseus	Tilleear, Gulabi Myna
18.	Sindh Pied wood Pecker	Picides Assimils	Sindh Khalkha
19.	Marbled Teal	Marmaronelta, Angustirostris	Mar Marian Batakh
20.	White Stock	Ciconi Ciconia	SafadLaqlaq/ AchhiToor



PROJECT DETAILS

4.1 INTRODUCTION

Considering the energy fed in the form of fuel, as compared with traditional power plants, cogeneration systems feature an overall yield that is significantly higher thanks to the combined production of electricity and thermal power: not to mention the ensuing energy savings and emission reduction.

Cogeneration therefore represents a strategic choice for companies as well as an opportunity for growth in terms of image and competitiveness:

- Better energy efficiency,
- Higher savings,
- Environmentally friendliness.

4.2 TYPE, CATEGORY AND OBJECTIVES OF THE PROJECT

Type of the project

Pakistan is an energy deficit country. Fossil fuels are already in short supply, and their local availability is fast depleting along with price hike taking place during very short intervals of time. Import bills of the fossil fuels are swelling at a very fast rate due to their fast increasing demand in the country. Pakistan's fragile economy cannot afford to continue with the present situation. Consequently, the present state demands to find/explore other sources which could fully or partially replace the fossil fuels presently in use.

HSM Energy Limited is planning to install a 26.5 MW Cogen power plant using Bagasse as fuel at Nawabshah, district Shaheed Benazirabad, Sindh. Bagasse is the matted cellulose fiber residue from sugarcane that has been processed in a sugar mill. The saving of this product has become one of the main objectives of the sugarcane industry. The actual tendency



is to use bagasse as fuel, especially for cogeneration of electric power and steam, to increase its contribution to the country's energy supply. The process flow diagram of the project is attached as Annexure VIII. Where the Cogen power plant is to be installed is located within the jurisdiction of the EPA, Government of the Sindh.

Category of the project

The Cogen power plant will produce 26.5 MW of electricity. The capacity of the plant is very small and all environmental impacts are well controlled. The project, according to the 'Sindh Environmental Protection Agency (Review of IEE and EIA) Regulations, 2014' the project falls in "**Category B**" requiring IEE to be submitted to the EPA Sindh for getting Environmental Approval(EA).

Objectives of the project

Pakistan is energy deficient. The total installed power generation capacity of Pakistan in 2010--11 was 23,412 MW. Out of this, 16,070 MW was thermal (69 percent), 6,555 MW was hydroelectric (28 percent) and 787 MW was nuclear (3 percent).

The growth in energy supply continues to lag behind the growth in energy demand.

The power shortage is estimated at over 6,000MW. This gap in power supply and demand is on the rise. Resultantly, Pakistan currently faces severe power shortages, which results in frequent and long drawn out load shedding. The frequency of the load shedding is also on the rise.

The "Energy Security Action Plan" developed by the Planning Commission of Pakistan, (2005) planned the increase in electric generation capacity. Planed electricity generation & installed capacity are presented in the following table:

Table 4.1: Planed Electricity Generation & Installed Capacity MW

Year	Nuclear	Hydro	Coal	Renewable	Gas + Oil	Total
		Power				



2005	400	6,460	160	180	12,340	19,540
2010	00	1,260	900	700	5,020	7,880
2015	900	7,570	3,000	800	7,850	20,120
2020	1,500	4,700	4,200	1,470	12,860	24,730
2025	2,000	5,600	5,400	2,700	22,790	38,490
2030	4,000	7,070	6,250	3,850	30,660	51,830
TOTAL	8,000	32,660	19,910	9,700	91,520	162,590

According to the Planning Department, Government of Pakistan (Daily Jang, Lahore, Janaury18, 2013),“it will not be possible to end load shedding during the planned year even if all power projects are completed on schedule”. It looks very difficult to bridge the gap between production and demand of electricity for a long time to come. It means load shedding will remain a constant feature in the country.

Therefore, HSM Energy Limited has planned to install a 26.5 MW Cogen power plant using bagasse as fuel with the aim of exporting power to electricity grid both during crushing season and off season. The power plant will be connected to the national grid through a loop in, loop out arrangement at the 132 kV transmission lines that is located at a distance of about 4.5 km from the proposed power plant. This is how the supply of reliable and economic power to the National Grid to meet ominous power demand of the country will be ensured and on the other hand the process steam demand of the Sugar Mill will also be met.

4.3 RENEWABLE ENERGY ALTERNATIVES

Renewable resources such as wind power, micro hydro, and solar photovoltaic are not feasible options at the current time, but are subject to future consideration, particularly with respect to the price of fuel. With availability of biomass and coal locally the option of using other renewable energy sources will be highly cost ineffective.



Moreover, high wind speed is only apparent for short periods of time in the project site area and hydro potential does not exist. Therefore, none of the currently available other renewable energy sources, at the utility level, will be able to meet the current needs.

Biomass Energy

Biomass energy is the energy which is contained inside plants and animals. This can include organic matter of all kinds: plants, animals, or waste products from organic sources. These sorts of energy sources are known as bio-fuels and typically include wood chips, rotted trees, manure, sewage, mulch, and tree components. Chlorophyll present in plants absorbs carbon dioxide from the atmosphere and water from the ground through the process of photosynthesis. The same energy is passed to animals when they eat them. It is considered to be as renewable source of energy because carbon dioxide and water contained inside plants and animals are released back in to the atmosphere when they are burned and we can grow more plants and crops to create biomass energy.

In many ways, biomass is a new source of power. While wood has always served as a fuel source for fires and ovens and conventional heating methods, biomass energy advancements are a few steps beyond that. Now these biomass fuel products are harvested and mass-produced and used in everything from engines to power plants.

No Harmful Emissions: Biomass energy, for the most part, creates no harmful Carbon dioxide emissions. Many energy sources used today struggle to control their carbon dioxide emissions, as these can cause harm to the ozone layer and increase the effects of greenhouse gases, potentially warming the planet. It is completely natural, has no such carbon dioxide side effects in its use.

Clean Energy: Because of its relatively clean use, biomass energy, when used in commercial businesses such as airlines, receives tax credit from the US Government. This is good for the environment and good for business. It does release Carbon



dioxide (CO₂) but captures CO₂ for its own growth. CO₂ released by fossil fuel are released into the atmosphere and are harmful to the environment.

Abundant and Renewable: Biomass products are abundant and renewable. Since they come from living sources, and life is cyclical, these products potentially never run out, so long as there is something living on earth and there is someone there to turn that living things components and waste products into energy. In the United Kingdom, biomass fuels are made from recycled chicken droppings. In the United States and Russia, there are plentiful forests for lumber to be used in the production of biomass energy.

Reduce Dependency on Fossil: It has developed as an alternate source of fuel and have helped them to reduce their dependency on fossil fuels.

Reduce Landfills: Another benefit of this energy is that it can take waste that is harmful to the environment and turn it into something useful. For instance, garbage as landfill can, at least partially, be burned to create useable biomass energy.

Less contribution to acid rain phenomenon: Less emissions of Sulfur dioxide (SO₂) and Nitrogen oxides (NO_x) resulting from biomass fuel combustion results in less contribution to acid rain phenomenon.

Elimination of unwanted solid wastes: Solid waste is a part of Biomass fuel when it is used is consumed as bio-fuel results in its elimination.

Advantages of the Site

Bagasse, which is a byproduct of the sugar production process, will be used as fuel for the power plant which is left over after crushing sugar cane at sugar industry. To meet the requirement of steam for power generation at HSM Energy Limited, it is



convenient that the site should be located within the vicinity of the sugar mill. Accordingly, the project site has been selected at the present site.

Alternatives considered (Site Selection), and reasons for their rejection:

Economic viability, investment limitations, market volume, ensured availability of raw materials, availability of dependable energy source, availability of project basic support systems and environmental management are the main considerations upon which plant production capacity has been determined.

All these factors were taken into consideration while selecting a suitable site for the project. While the rest of the sites were rejected on one or the other important requirements for the success of the project, the present place from all points of view was the most suitable. The major points taken into consideration and their summary discussion, for the site selection included:

4.4 ENVIRONMENT

Environment consideration of industrial sitting is of utmost importance. The plant is to operate according to the Environment Management Plan. Necessary safeguards are to be provided to minimize all type of pollutants. Therefore, emissions are to remain within the prescribed limits of the Sindh Environmental Quality Standards (SEQS)

Therefore, power plant can be installed at any available piece of land, without any danger of adverse impacts on environment and human health. Accordingly, the site selected for the power plant is quite suitable.

Waste water disposal facility

Effluent generated from Cogen power plant will be neutralized and will be let into the treatment plant. The treated water will be used for the irrigation purpose inside the plant boundary walls and left over if any, can be used for agriculture purpose.



Land Availability

Sufficient land is available for the power plant installations in the vicinity of Habib Sugar Mills Nawabshah, District Shaheed Banazirabad, Sindh.

Basic Infrastructure and facilities

Basic infrastructure like water, roads, transport and communication facilities like telephone, fax, and E-mail are already available at the project site. This factor also goes in favor of selecting the present site.

Labor availability

All categories of the labor required for the project operation are available conveniently and plentifully at affordable cost at the project site. This factor too supports sitting of the project at the present site. The installation of new plant will give job to almost 30 engineers and 300 labors during construction phase and 200 plus people during operation phase.

Raw material

Availability of raw material in the required quantity throughout the production was the first and foremost priority.

Availability of water

Water required for plant operations is plentifully available at the project site. On the basis of above main considerations the site selected for the Power Plant is quite suited.

Size or magnitude of the operation, including capital cost, and associated Activities:

The project aims at the installation of 26.5 MW Cogen power plant using Bagasse as fuel. This power plant is installed in the close vicinity of Habib Sugar Mill. The estimated cost of the project is Rs.03 Billion. It will require about 51,395 sq. meters covered area for plant and 29,542 sq. meters for Bagasse yard.

4.5 PROJECT IMPLEMENTATION STAGES



Project Implementation Stages along with their time frame are given hereunder:

- Award of contract for boiler: May to July 2017
- Award of contract for turbines: May to July 2017
- Award of LOI for switchyard & transformer package: One Month
- Award of LOI for fuel & ash handling system: May to July 2017
- Expected date for award of contracts for balance of plant packages: July 2017

all the packages are given on EPC basis

- Expected date of boiler erection & commissioning: February 2019
- Expected date of turbine erection & commissioning: March 2019
- Expected date of switchyard erection & commissioning: March 2019
- Expected date of COD: April 2019

Description of the Project

The plant layout is attached as Annexure VII. While relevant details of the project are described in the aforesaid section 1.2, more technical detail is given here under.

Raw Materials

The major raw material for this project is Bagasse, which is a byproduct of the sugar production process. The Co-generation power plant will use bagasse produced by Habib Sugar Mills Limited as well as purchase from other sugar mills..

Water Requirement

About 3,480 m³/day during season and 2,040 m³/day during off season water will be required during operation of the plant. Underground water will be used which is plentifully available at the project site. R.O. Plant with capacity of 30-40 Tons/hr will be installed.



Energy

The energy required for the plant operation will be obtained from self-generation.

Major Equipment

The following are major items included among the main equipment:

- 110-bar Traveling Grate Boiler
- 26.5 MW extraction condensing turbo generator
- DCS & Instrumentation
- Fuel & ash handling system
- Cooling tower
- Switchyard and Transformers
- Water Treatment Plant
- Low voltage package
- VFDs and Drives
- Plant Piping & Appurtenances
- Ventilation & Air Conditioning System
- Fire Fighting System
- EOT crane
- Cables and other packages

4.6 PLANT TECHNOLOGY SUPPLIERS

- Boiler – any reputed vendor from India/China
- Turbine – any reputed vendor from India/China
- Switchyard and transformers – Siemens Pakistan or any reputed and NTDC approved vendor from China



- Fuel & ash handling system – Any reputed vendor from India/China
- EOT crane – Any reputed vendor from India/China
- Water treatment plant – WEMS Pakistan
- Cooling towers – Tru water Malaysia or any reputed vendor from India/China
- Drives/Motors/Instrumentation – any reputed vendor from India/China

Hours of Operation

The plant will remain operation for 24 hours a day during the operational season of the sugar mill.

4.7 DETAILS OF RESTORATION AND REHABILITATION AT THE END OF THE PROJECT LIFE

The cogeneration power plant is expected to have a project life of 25 years. Once the useful life of the new plant will be over, it will be refurbished completely. A comprehensive mechanical, electrical and civil structural overhaul will be carried out. To bring the plant to date with the then technology available, all necessary equipment replacements will also be done. In this way, the plant will be revived for another term of its useful life. The redundant parts and equipment will be sold in the market for recycling.

This all will be done conforming to the environmental management and controls so as to avoid any damage to any segment of environment or human health.

Government approvals and leases required by the project

No objection certificate (NOC)/Environmental Approval (EA) from the EPA, Sindh, is the major requirement to start work on the project

SCREENING OF POTENTIAL ENVIRONMENTAL

5.1 ENVIRONMENTAL PROBLEMS DURING CONSTRUCTION AND MITIGATION MEASURES

Environmental problems due to project location

The project aims at installation of Cogen power plant using Bagasse as fuel at Nawabshah, district Shaheed Benazirabad, in the province of Sindh, Pakistan. As the new project is within the premises of existing Habib Sugar Mills Ltd, no new land is being procured and an Environmental Management Plan is to be followed covering all activities during construction phase, no environmental problems are envisaged due to the project location.

Environmental problems related to design

The plant is to be designed in a way that it complies with the required limiting values as set under the SEQS. Under the conditions no environmental problem worth mentioning relating to design are envisaged.

Third party half yearly monitoring

Third party half yearly monitoring will further ensure compliance with the required standards.

5.2 ENVIRONMENTAL PROBLEMS RESULTING FROM CONSTRUCTION

The most likely environmental problems to occur during construction phase could due to:

- Construction machinery
- Compaction of soil activity
- leveling of land
- moving vehicles
- Construction of building and associated civil work



The pollution from these activities could be in the form of:

- Gaseous emission of SO₂, NO_x and CO, hydrocarbons etc
- Particulate Matter (PM)
- Noise
- Effluent

In the first place, construction activity is going to be on very limited scale and for short duration, therefore, magnitude of emissions/pollutants will not be significant. The scheduled traffic plan, of the vehicles visiting plant regularly, will further ensure that the environmental pollution does not adversely affect the people and environment.

The scale of erection and commissioning will also be small, thus the potential contribution of noise and dust as pollutants will also be very small and will be curtailed within the plant boundaries. Lastly, a dedicated Environmental Management Plan will be operational during construction (EMPc), which further ensure that environmental problems arise during construction are well managed within the required limits of the SEQS.

5.3 ENVIRONMENTAL PROBLEMS RESULTING FROM PROJECT OPERATIONS

The technology suppliers/designers and fabricators enjoy international reputation. The boilers will be designed in a way that all sort of emissions from them meet the required levels of the SEQS Pakistan.

Noise levels:

Since most of the machinery will be placed within the built up area thus ensuring noise level compliance with the required standards. Wherever necessary, double housing to the rattling parts of the machinery, is to be provided for reduction of noise levels. This is to be incorporated at the design stage of the plant. The maximum noise levels will not increase from 75 dB(A) during day time and 65 dB(A) during night time thus will remain in compliance with the limits of the SEQS limits.



Boiler Stack Emissions

Boiler stack emissions of concern are primarily Nitrogen oxides (NO_x), Carbon monoxide (CO) and Particulate Matter (PM) and Sulphur dioxide SO₂. CO emissions are a function of plant operations such as the level of excess air and maintenance of combustion temperature and residence time; therefore, its concentrations can be easily controlled while controlling these factors. State of the art technology (if and wherever required) to reduce CO, NO_x and SO₂ and Particulate Matter (PM) emissions will be used.

Ash Handling

An Electrostatic Precipitator (ESP) will be used to collect the fly ash and together with the bottom ash from the boiler, the bagasse ash will be used as manure / fertilizer on corporate farms and also made available to growers in the region. Total ash generated will be 1,900 kg/hr, comprising wet ash of 760 kg/hr and dry ash of 1,140 kg/hr. Temporary storage of the ash on site shall be done in enclosed silos. Transportation of ash from the site to farms will be done using best environmental practices to avoid any spillage into the environment.

SO₂ emissions

After the plant startup, SO₂ emissions will be in traces as the Sulfur content in the fuel is very less.

NO_x emissions

After the plant startup, NO_x emissions will be less than 250 ppm due to the very low level of Nitrogen content in bagasse.

The maximum stack emissions of SO₂ and NO_x will not exceed the permissible limits of the SEQS.

Particulate Matter (PM) emissions:

PM emissions will be approximately 150 mg/n.cu.m and will be controlled by the ESP in the boiler out let and bag filters at areas like Ash silos to remain within the prescribed limits of the Sindh Environmental Quality Standards (SEQS) limits.

Effluents:



About 120–150 m³/day effluent will be generated by the plant. The Effluent generated from Co-generation power plant will be neutralized and will be treated inlet into the existing sugar ETP. The treated water from the sugar ETP will be used for agriculture purpose and for sprinkling inside the plant boundary wall and left over if any, discharged into the nearby farms of HSM Energy Limited.

5.4 ENVIRONMENT MANAGEMENT PLAN /MITIGATION / COMPENSATION MEASURES

DURING CONSTRUCTION PHASE

Potential	Mitigation/ Compensation Measures Impact
Air Quality	<ol style="list-style-type: none"> 1. Vehicles transporting loose construction material to be covered with tarpaulins. 2. Limit on speed and movement of vehicles, where considered appropriate speed-breakers should be installed 3. Use low emissions trucks/vehicles for material transport where possible. 4. Routine service and maintenance of vehicles and machines to reduce engine emissions. 5. During periods with abnormal wind speeds, in particular during dry weather conditions, workers on the construction site should be provided with adequate inhalation and eyes protection gears. In case particulates in air hamper a clear view over the site completely, so that safety is impaired, the construction should be interrupted until weather conditions improve. 6. To reduce generation of dust in the construction process, onsite roads and parking areas, as far as possible, would be constructed with asphalt over a compacted sub base. 7. Spraying exposed soil with water to reduce PM emissions. Water to be applied at a rate to maintain a moist surface, but not create surface water runoff or erosion



	<p>conditions.</p> <p>8. Provide wheel washers to remove particulate matter that would otherwise be carried offsite by vehicles that would decrease deposition of particulate matter on area roads and subsequent entrainment from those roads.</p> <p>9. Routing and scheduling construction trucks to reduce delays to traffic during peak travel times would reduce secondary air quality impacts caused by a reduction in traffic speeds while waiting for construction trucks.</p> <p>10. As far as possible planting vegetative cover (matching the Local climate), as soon as possible after grading, would reduce windblown particulate matter in the area.</p>
Water Supply	<p>1. During construction, non-potable water would be supplied by trucks to provide dust control.</p> <p>2. Potable drinking water for construction workers would be provided by a water service to be contracted by the site contractor</p>
Ground Water	<p>1. Any liquid material and lubricants (e.g. hydrostatic Testing. Water and wastewater) that accumulate during the construction phase should not infiltrate into the soil that have a direct contact to the ground water. Septic tanks shall be used for any waste water collection. Each tank, when filled and closed, should be brought to the closest wastewater treatment plant for further treatment.</p> <p>2. Closed tanks should be removed from the site as soon as possible and should not be allowed to remain on the construction site as an interim storage until the end of the construction phase.</p> <p>3. Monitoring of the characteristic of waste water collected in the septic or other tanks should be carried out on routine basis.</p> <p>4. Maintenance and washing of all mobile machinery & vehicles should be carried out</p>



	<p>at adequate service stations. Good and regular maintenance of all vehicles and machines used on site is mandatory.</p> <p>5. Maintenance and refueling (if necessary) of any construction equipment shall be done at a decent distance from the excavation area and only be undertaken on sealed area. Any re-fuelling must be handled carefully taking particular attention to not spilling any fuel.</p> <p>6. On site storage of fuel, engine oil and lubricants (if any) shall be in locked tanks, sealed and shadow roofed area.</p> <p>7. On site storage of fuel, engine oil and lubricants that might be stored shall be collected at the end of construction phase and brought to either a disposal point as hazardous</p> <p>8. Waste or be brought back for re-use to the place it was rented for the purpose of this construction.</p>
Solid Waste	<p>1. All solid wastes shall be disposed off according to a set Procedure and record of sales will be kept to track at any time when it is required.</p> <p>2. The contractors to whom any waste is to be sold shall be fully made aware of the environmental impacts and health effects of the waste to be sold to him. He shall be provided Instructions for reuse / handling of such wastes in environmentally sustainable way.</p>
Soil	<p>1. Construction activities must be limited to the designated areas.</p> <p>2. Refilling of excavated soil should be done as far as possible. Where possible reuse of excavated soil should be done.</p> <p>3. Prevention measures should be developed in the event of an accident or threat (e.g.</p>



	massive, uncontrolled leakage of waste water into unsealed soil on-site).
Fauna and flora	<ol style="list-style-type: none"> 1. Planting of indigenous grass, trees and bushes between the edge of the site and the adjacent un-utilized area should be carried out. If not earlier practical, such measures should be implemented after the completion of all construction activities 2. Develop green strips of suitable vegetation, along the access road to improve the landscape shape
Noise	<ol style="list-style-type: none"> 1. Power mechanical equipment like bulldozers, air compressors, Concrete pumps, excavators, concrete mixers etc. shall only be used with low sound power, whenever possible. 2. Optimize transportation management to avoid needless truck trips; avoidance of truck movements in residential areas at least during night time. 3. The building machinery and equipment shall be well-maintained and serviced regularly during construction phase. 4. Silencers or mufflers on construction equipment shall be used. 5. Whenever possible, mass construction material and excavated soil shall be stored in direction of the nearest habitat as noise barrier. 6. Construction activities shall be scheduled in such a way that noise intensive operations side by side with an increased net noise level will be avoided. 7. Workers on the construction site should be equipped with ear protection in particular those directly exposed to higher noise levels.

5.5 ENVIRONMENT MANAGEMENT PLAN / MITIGATION / COMPENSATION MEASURES

DURING OPERATION PHASE

Potential	Mitigation / Compensation measures Impact
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Landscape	<ol style="list-style-type: none">1. To the extent possible, develop a green belt along the facilities boundary area and other open spaces, to create to some extent a natural landscape. The flora to be used for such green belt should be tolerant to the local climate
Ambient Air Quality	<ol style="list-style-type: none">1. Continuous monitoring of ambient air for SO₂, NO_x, and PM to be carried. Sindh Ambient Air Quality Standards (SAAQS), 2014 will also be applicable Standards.
Surface Water	<ol style="list-style-type: none">1. Waste water treatment, as described in this report, to be carried out continuously and monitored.
Ground Water	<ol style="list-style-type: none">1. Regular inspection of facilities for intercepting leaking and spilled liquids.2. Hazardous chemicals shall be handled only in appropriate segregated, sealed and bundled areas at Site.
Solid Waste	<ol style="list-style-type: none">1. All solid wastes shall be disposed off according to a set procedure and record of sales will be kept to track at any time when it is required.2. The contractors to whom any waste is to be Sold shall be fully made aware of the environmental impacts and health effects of the waste to be sold to him. He shall be provided instructions for reuse/handling of such wastes in environmentally sustainable way.
Noise	<ol style="list-style-type: none">1. Equipment will be acoustically shielded and or lagged as far as possible.2. A noise measurement campaign during full operation at operation start should be implemented to verify the real noise levels are in line with SEQS.3. Workers should be obliged to use ear protection in areas within the plant and for specific work that exceed the tolerable maximum noise limits.4. Double housing of the rattling parts will be incorporated at the design stage in the area wherever necessary to ensure noise level reduction to the NEQS.



Ash handling	<ol style="list-style-type: none">1. Bottom Ash and fly ash generated by burning bagasse in the boiler will be used as manure / fertilizer in corporate farms and also made available to other growers in the region.2. The ash will be stored in enclosed silos on site. Transportation of the ash from the site will be done through trucks to be completely covered with tarpaulin to avoid any ash being spread on the roads during transportation.
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With all these arrangements in place Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMtP), as recommended in this report will also be operational as legal requirement under the Sindh Environmental Protection Act - 2014. This will further ensure the power plant operation in environmentally sustainable fashion.

Besides the concrete measures to be adopted as described above, the quality of environment will further be enhanced through the running of project in complete accordance with the 5Rs Principles-Reducing, Recycling, Reusing, Refurbishing and Retrofitting. Good housekeeping will be the order of the day. Tree plantation on the project site and its vicinity will be carried out.



ENVIRONMENTAL MANAGEMENT PLAN

6.1 INTRODUCTION

The Environmental Management Plan (EMP) will be used to ensure that the proposed power plant is operated with minimum environmental impact as permissible under the Sindh Environmental Quality Standards (SEQS)

In order to accomplish this objective, the environmental management systems described will comprise of: Environmental Management Plan, Environmental Monitoring Plan (EMP), and Resources Implementation and Training Program. This EMP will serve as a guideline for the minimum requirements of the detailed procedure to be developed, updated and revised as needed throughout the construction and operation phases of the Project. The construction vender will be responsible for preparing and implementing a detailed worker health and safety plan, a copy of which should be provided to Company prior to start-up of construction activities.

6.2 ENVIRONMENTAL MANAGEMENT PLAN (EMP)

It should be stated that full-time monitoring will be required both during the construction phase and operations phase of the project. The EMP task will likely be administered by the “Health, Safety and Environment (HSE) Department”, who will have the authority where necessary to “stop the job” if an environmentally detrimental activity is being conducted. The EMP operation/implementation will be the responsibility of the “HSE Officer”, who will be coordinating, arranging the collection and reporting of the results of all emissions, ambient air quality, noise and water quality monitoring. Environmental Management Plan includes the protection, mitigation and environmental enhancement measures to be implemented to reduce to a minimum the adverse impact on the environment. The adverse environmental impacts during the functional phase of the proposed project under normal operating conditions are from air emissions, wastewater generation, noise and solid waste generation. Environmental Management Plan (EMP) is presented in this chapter. Mitigation and



compensation measures to address the environmental issues during construction of the project are discussed in Section-6.3.

The mitigation and compensation measures essential to meet the requirement during operation of the proposed project are described in Section – 6.4 of this Chapter. In Section-7.4, monitoring recommendations are presented for documenting the compliance of the project to the SEQS and the standards under “Pollution Prevention and Abatement Handbook, WORLD BANK GROUP, effective July 1998” for Thermal Power: Guidelines for New Plants.

6.3 MITIGATION / COMPENSATION MEASURES DURING CONSTRUCTION PHASE

Potential Impact	Mitigation Action
Air Quality	<ol style="list-style-type: none"> 1. Vehicles transporting loose construction material (clay, sand etc.) to be covered with tarpaulins. 2. Limit on speed and movement of vehicles, where considered appropriate speed-breakers should be installed 3. Use low emissions trucks for material transport where possible (e.g. use of diesel particulate filter) 4. Routine service and maintenance of vehicles and machines to reduce engine emissions. 5. During periods with abnormal wind speeds, in particular during dry weather conditions, workers on the construction site should be provided with adequate inhalation and eyes protection gears. In case particulates in air hamper a clear view over the site completely, so that safety is impaired, the construction should be interrupted until weather conditions improve. 6. To reduce generation of dust in the construction process, on site roads and parking areas, as far as possible, would be constructed with asphalt over a compacted sub base.



	<ol style="list-style-type: none">7. Spraying exposed soil with water to reduce PM_{10} emissions and particulate matter deposition. Water to be applied at a rate to maintain a moist surface, but not create surface water runoff or erosion conditions.8. Provide wheel washers for vehicles to remove particulate matter that would otherwise be carried offsite by vehicles that would decrease deposition of particulate matter on area roads and subsequent entrainment from those roads.9. Routing and scheduling construction trucks to reduce delays to traffic during peak travel times would reduce secondary air quality impacts caused by a reduction in traffic speeds while waiting for construction trucks.10. As far as possible planting vegetative cover (matching the local climate), as soon as possible after grading, would reduce Windblown particulate matter in the area.
Surface Water	<ol style="list-style-type: none">1. All liquid materials and lubricants (e.g. sanitary waste water, etc.) that accumulate during construction phase shall be stored in closed septic tanks, and in containers or barrels stored in specifically identified areas at the construction site.2. Packaging material like bags of cement etc. shall be stored in containers to avoid leaching out of any remaining particles in the event of rain fall, etc.
Water Supply	<ol style="list-style-type: none">1. During construction, non-potable water would be supplied through



adequate water supply system to be installed at the project.

2. Potable drinking water for construction workers would be provided by a water service to be contracted by the site contractor

Ground Water

1. Any liquid material and lubricants (e.g. hydrostatic testing, water, chemical cleaning water and wastewater) that accumulate during the construction phase should not infiltrate into the soil that have a direct contact to the ground water. Septic tanks shall be used for any waste water collection. Each tank, when filled and closed, should be brought to the closest wastewater treatment plant for further treatment.
2. Closed tanks should be removed from the site as soon as possible and should not be allowed to remain on the construction site as an interim storage until the end of the construction phase.
3. Monitoring of the characteristic of waste water collected in the septic or other tanks should be carried out on routine basis.
4. Maintenance and washing of all heavy mobile machinery & vehicles should be carried out at adequate service stations.
5. Good and regular maintenance of all vehicles and machines used on site is mandatory and the waste water should not be allowed to drain into the canal.
6. Maintenance and re-fueling (if necessary) of any construction equipment shall be done at a decent distance from the excavation area and only be undertaken on sealed area. Any re-fuelling must be handled carefully taking particular attention to not spilling any fuel.
7. On site storage of fuel, engine oil and lubricants (if any) shall be in



	<p>locked tanks, sealed and shadow-roofed area.</p> <p>8. On site storage of fuel, engine oil and lubricants that might be stored shall be collected at the end of construction phase and brought to either a disposal point for hazardous waste or be brought back for re-use to the place it was rented for the purpose of this construction.</p>
Solid Waste	<p>1. All solid wastes shall be disposed-off according to a set procedure and record of sales will be kept to track at any time when it is required.</p> <p>2. The contractors to whom any waste is to be sold shall be fully made aware of the environmental impacts and health effects of the waste to be sold to him. He shall be provided instructions for reuse/handling of such wastes in environmentally sustainable way.</p>
Soil	<p>1. Construction activities must be limited to the designated areas.</p> <p>2. Refilling of excavated soil should be done as far as possible. Where possible reuse of excavated soil should be done.</p> <p>3. Prevention measures should be developed in the event of an accident or threat (e.g. massive, uncontrolled leakage of wastewater into unsealed soil on-site).</p>
Fauna and flora	<p>1. Planting of indigenous grass, trees and bushes between the edge of the site and the adjacent un-utilized area should be carried out. If not earlier practical, such measures should be implemented after the completion of all construction activities</p> <p>2. Development of green strips of suitable vegetation for zone, along the access road that helps birds and animals to migrate and improve the</p>



	landscape shape.
Noise	<ol style="list-style-type: none"> 1. Power mechanical equipment like bulldozers, air compressors, concrete pumps, excavators, concrete mixers etc. shall only be used with low sound power, whenever possible 2. Optimize transportation management to avoid needless truck trips; avoidance of truck movements in residential areas at least during night time. 3. The building machinery equipment shall be well-maintained and serviced regularly during construction phase. 4. Silencers or mufflers on construction equipment shall be used. 5. Whenever possible, mass construction material and excavated soil shall be stored in direction of the nearest habitat as noise barrier. 6. Construction activities shall be scheduled in such a way that noise intensive operations side by side with an increased net noise level will be avoided. 7. Workers on the construction site should be equipped with ear protection in particular those directly exposed to higher noise levels.

6.4 MITIGATION / COMPENSATION MEASURES DURING OPERATION PHASE

Potential Impact	Mitigation Action
Landscape	<ol style="list-style-type: none"> 1. To the extent possible, develop a green belt along the facilities boundary area and other open spaces, to create to some extent a natural landscape. The flora to be used for such green belt should be tolerant to the local climate requiring just minimum water to survive.



Ambient Air Quality	<ol style="list-style-type: none">1. Continuous monitoring of ambient air for SO₂, NO_x, CO and PM to be carried.2. Height of the stacks to be maintained at 100 meters, as indicated in the project feasibility report, for enhanced dispersion of pollutants
Surface Water	<ol style="list-style-type: none">1. Waste water treatment, as described in this report, to be carried out continuously and monitored before mixing with water in the recipient water body
Ground Water	<ol style="list-style-type: none">1. Regular inspection of facilities for intercepting leaking and spilled liquids.2. Hazardous chemicals shall be handled only in appropriate segregated, sealed and bundled areas at site
Solid Waste	<ol style="list-style-type: none">1. All solid wastes shall be disposed off according to a set procedure and record of sales will be kept to track at any time when it is required.2. The contractors to whom any waste is to be sold shall be fully made aware of the environmental impacts and health effects of the waste to be sold to him. He shall be provided instructions for reuse/handling of such wastes in environmentally sustainable way.
Noise	<ol style="list-style-type: none">1. Equipment will be acoustically shielded and /or lagged as far as possible.2. A noise measurement campaign during full operation at operation start should be implemented to verify the real noise levels are in line with the standards under " Pollution Prevention and Abatement Handbook,



	<p>WORLD BANK GROUP, Effective July 1998” for Thermal Power: Guidelines for New Plants.</p> <p>3. Workers should be obliged to use ear protection in areas within the plant and for specific work that exceed the tolerable maximum noise limits.</p>
Bagasse Handling	<p>1. Adequate measures, as practiced internationally, should be adopted to eliminate the possibility of generation of bagasse dust during handling, conveying and storage.</p>
Ash Disposal	<p>1. Adequate measures for collection, loading, transporting, unloading and storage of fly ash and bottom ash should be adopted to ensure minimum possible emissions of ash and dust, and reduction of its adverse impact on environment. In order to reduce fugitive dust, drop distances at trucks ash loading points and unloading points should be minimized.</p> <p>2. During transport of the ash from point of transfer to the unloading point, the trucks/trolleys should be adequately covered preferably with tarpaulins and on surface spray of water, if possible with further help to reduce fugitive dust. Workers to perform duties relating to ash handling should be protected by providing them all necessary protective gears and their use should be made mandatory.</p>

6.5 ENVIRONMENTAL MONITORING PROGRAM AND INSTITUTIONAL REQUIREMENTS

The project aims at installation of 26.5 MW Cogen power plant using bagasse as fuel is located at Nawabshah, district Shaheed Benazirabad, Sindh Environmental Management Plan (EMP) and Environmental Monitoring Programme (EMtP) as recommended for the project will ensure that all type of pollutants from the projects remain within the prescribed limiting values of the NEQ- Pakistan.



Assigning responsibility for implementation (by name or position)

For effective environment management, responsibilities are set for each operation as follows:

Official concerned	Responsibility
General Manager/ PlantIn-charge	<ul style="list-style-type: none">• Over all in-charge of all the Environmental Management Plan (EMP) and EMtP.• He will be responsible to ensure smooth functioning of the EMP and EMtP/ system• Daily progress on the state of the environmental status will be reported to him in writing by his junior responsible staff.• All other Environmental Management and Monitoring matters, issues and problems will be reported to him for rectification.• He will work as bridge between the Government concerned authorities and the inside E.M.• He will be answerable to the higher management in all matters relating to E.M.• During his shift timings, he will be responsible to look into smooth functioning of the process in environmentally sustainable fashion.
Shift Engineer/ In Charge	<ul style="list-style-type: none">• He will be responsible to rectify any problem regarding environmental matters.• He will directly report all matters regarding E.M. to the G.M.• He will record emissions behavior on hourly basis and will report to the Shift Engineer.



Plant Operator	<ul style="list-style-type: none"> • He will be responsible to carry out all tests regarding environmental monitoring which includes Gaseous emissions monitoring, particulates monitoring, sound levels monitoring etc. according to the monitoring scheduled and will report to the Shift Engineer/In Charge
Laboratory Chemist	

6.6 MONITORING PROGRAM TO ASSESS PERFORMANCE

According to "Guidelines for Self-Monitoring and Reporting by Industry (SMART)," Final Report, March 1998, approved by Pakistan Environmental Protection Council (PEPC), in August 1999, Power Plant falls under "Category B" regarding monitoring of gaseous emissions. All out environmental monitoring of the power plant should be carried out according to the schedule as recommended in the SMART.

After the plant start-up, once a comprehensive monitoring report for all SEQS parameters for normal plant operations should be carried out at the start of the operation and the same should be reported to EPA Sindh. This is to establish that the plant does meet the environmental commitments made in this IEE Report. This monitoring should be carried out by a third party. Thereafter, subsequent regular monitoring will be restricted to priority parameters as suggested in the SMART.

Reporting will be done according to the format as approved in the SMART. Even though all effluent generated through the entire project activities along with sewage will be treated in the designed waste water treatment plant and all relevant data regarding generation, treatment and disposal mode of the effluent will be duly recorded.

A track record of all solid wastes and their disposal shall also be regularly maintained for its use as and when required. All monitoring data should be reviewed and analyzed regularly in comparison with the SEQS limiting values. In case of any deviation/violation of the required standards, immediate necessary corrective actions should be taken. All the monitored data should be reported to the EPA Sindh.



Wastewater/Thermal Discharge

Treated wastewater and cooling water will be monitored as required by applicable environmental regulations. Additional training is recommended to educate facility operators of the sensitivity of the underlying aquifer and the importance the protection of this resource is to the people of area. Under no circumstances should untreated contaminated waste water be permitted to be discharged. Site management will ensure that the potential for oily water discharge via site drainage is minimized by ensuring that the necessary procedures are in place to provide adequate maintenance of oil/ water interception units into which all plant discharges are conveyed and installing additional oil/ water separators where necessary. Based upon experience the largest capacity systems as are practical should be installed.

Noise

An ambient noise measurement program should be instituted upon commissioning of the project. The monitoring program should consider the noise limits during day-time and night-time at the closest point of public contact

Reporting and reviewing procedures

Monitoring schedule, as explained above will be adhered to and all the data to be monitored will be scrutinized at the level of Shift Engineer/ In Charge and on monthly basis at the G.M. level. The data will be documented according to appropriate format. Discrepancies will be duly addressed to, for presentation of the data to the Government Agencies, approved data recording to the SMART format.

Training needs

Environment monitoring staff will trained in the required field of environmental issues relating to the power plant.

Environmental Monitoring

Environmental monitoring will be carried out by the staff to be engaged for the purpose.



Environment quality monitoring laboratory

The environmental monitoring laboratory will be set up at the project site. Portable flue gas analyzer, Particulate matter monitoring instrument and Sound Level Meter will be made available in plant environmental laboratory.

Maintenance

The plant will be maintained to ensure that pollutants releases to the environment are minimized. Records will be kept to show what maintenance has been carried out. This would apply to a range of areas including combustion optimization, fuel handling and monitoring equipment

Ecological Monitoring

Flora and fauna inventories within the power station area will be monitored on a twice yearly basis, as well as before and during the construction and early operating activities. This may involve the use of specific indicators, such as the occurrence of nests or nesting bird species of importance. It is intended that the implementation of the monitoring program will be conducted on a co-operative basis by the various stakeholders in the area. The flora and the fauna monitoring may also be contracted out to a third party.

During the construction phase, the Project Manager will be responsible for overseeing land clearing activities and be involved in the scheduling of these activities in order to prevent them from being undertaken during periods of heavy rainfall whenever possible. However, in the event the scheduling of the activities must be undertaken during periods of heavy rainfall measures will be employed to reduce the risks of erosion.

6.7 SOCIAL MANAGEMENT PLAN

Recommendations and Mitigation Measures



Based on the initial benchmark study the recommendations are made:

- The management of the Project can capitalize on the positive attitude of the people of area towards proposed Project by offering them maximum employment opportunities at the construction stage and stage of operational phase of the power plant.
- Insufficient and inadequate socio-economic structure of the community of the area also provides ample opportunities to Company management to win sympathies of local people in their favor, by introducing meaningful and manageable plan of community development.
- Aggressive and comprehensive plantation plan can also lessen fear of local people towards environmental issues.
- Plant management can explore direct or indirect chances of female employment opportunities. Such efforts can be fruitful to minimize negative social impacts.
- Sustainable development approach through conservation of natural resources would be the best strategy to compensate negative socio environmental impacts.
- Plant management should offer technical training opportunities to the local youth, if possible, to remove relative sense of deprivation Social responsible attitude and stewardship of company management towards local people and resources can make project people friendly.
- Prior to action of the Project installation a comprehensive awareness campaign may be launched at masses level to avoid any conflict.
- To avoid any political, ethnic and value conflict, the administration of the plant may win the confidence of local powerful elites, authorities, leaders and interest groups by adopting informal confidence building measures



CONCLUSION

7.1 CONCLUSION

The analysis performed to fulfill the IEE requirement follows international standards. The IEE establishes the baseline condition of the site and assesses the impact of the proposed generation facility on area resources. The likely positive and negative impacts of the proposed project are identified and quantified to the extent possible. Mitigation measures to be taken during construction and operation of the facility and any residual negative impacts are identified.

- The planned generation facility is a state of the art combined cycle unit and will meet all applicable international standards for air emissions.
- Modeling was performed as part of the IEE to assess the impacts of the air emissions on local air quality.

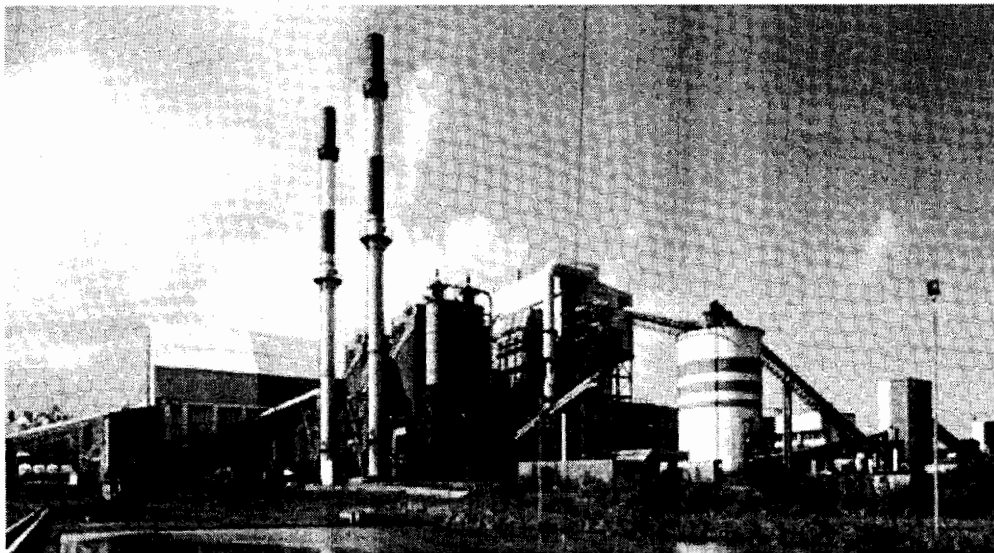
7.2 FINAL CONCLUDING REMARKS

In summary, the planned facility meets all international environmental standards and will have a positive impact on the local economy without stressing the local infrastructure and services. In addition, the facility will alleviate many of the severe problems currently being experienced in the Albanian electric power system



INTERCONNECTION STUDY

For
**26.34 MW HSM Energy Limited at Habib
Sugar Mills, Nawabshah, Sindh**



*Draft Report
(April 2017)*

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Executive Summary

- ❖ The Draft Report for interconnection of 26.34 MW HSM Energy Limited (under incorporation) Bagasse based Cogeneration Power Plant with HESCO grid system is submitted herewith.
- ❖ HSM Energy Limited would like to go for high pressure cogeneration with the aim of exporting a maximum of 21.27 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.
- ❖ This study is carried out for HSM Energy Limited (located in district Nawabshah) in integration with five other newly proposed bagasse based cogeneration power plants in the network of HESCO. Two out of these four PPs, namely Mehran Energy Limited and Tay Powergen (PVT) Ltd. lie in District Tando Allah Yar. Mirpurkhas Energy Limited is located in District Mirpurkhas. Habib Sugar Mills PP is located in Benazir Abad district. Faran Power Limited and Digri Sugar Mills PP are located in District Tando Muhammad Khan. The network around HSM Energy Limited (referred to as HSM PP in the remainder of the report) at 132 kV and 11 kV has been modeled as shown in Appendix-B.
- ❖ The nearest HESCO grid facility available for interconnection to HSM PP would be Nawabshah 132 kV Grid Station and Sanghar Road 132 kV Grid Station.
- ❖ Keeping in view the location of Power Project, it is proposed to connect HSM Energy Limited via looping In-Out of the existing Transmission Line from 132 kV Nawabshah grid station to Sanghar Road 132 kV grid station. The looping distance as confirmed from site visit would be 0.5 km and the conductor used would be Lynx. The scheme is shown in Sketch-2 in Appendix-B.
- ❖ HSM PP 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. Percentage Reactance of these step-up transformers is proposed to be 12.5% on ONAN base.
- ❖ The proposed scheme would require two 132 kV line bays at the 132 kV substation of HSM PP for the connection to 132 kV Nawabshah Grid Station and Sanghar Road 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 26.34 MW, the spillover from HSM PP would be 21.27 MW in Off-Season and 15.08 MW in the Crushing Season.
- ❖ In view of planned COD of HSM PP in August 2019, the above proposed interconnection scheme has been tested for steady state conditions through detailed load flow studies for the following scenarios:
 - Peak and Off-Peak Load Conditions of Summer 2019 for maximum hydropower dispatches in the grid during the Off-Season for HSM PP.
 - Peak Load Conditions of Winter 2020 for maximum thermal power dispatches in the grid during the Crushing Season for HSM PP.

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 Summer 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 21.27 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 HSM PP 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 HSM PP.
- ❖ The maximum short circuit levels of HSM PP 132 kV are 5.43 kA and 4.94 kA for 3-phase and 1-phase faults respectively for the year 2019. The same values for the year 2021 are 5.88 kA and 5.16 kA. It would be advisable to go for standard size switchgear of short circuit rating of 40 kA for the 132 kV and 11 kV bus bars at substation of HSM. 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 Summer 2019. The stability check for the worst case of three phase



fault right on the 132 kV bus bar of HSM PP 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

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- **NTDC Transmission Plan**
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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 HSM Energy Limited



1. Introduction

1.1 Background

HSM 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 Nawabshah 132 kV Grid Station and Sanghar Road 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 HSM PP 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 HSM PP.
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 HSM PP is one. The following data have been provided by the Client:

2.1 HSM PP data

Generator data:

Gross capacity of power plant	= 1 x 26.34 = 26.34 MW
Lump sum MVA capacity	= 1 x 33.13 = 33.13 MVA
Generating Voltage	= 11 kV
Power factor	= 0.80 lagging

Crushing Season:

Load + Auxiliary Consumption	= 11.265 MW
Spillover to the Grid	= 15.08 MW

Off-Season:

Load + Auxiliary Consumption	= 5.07 MW
Spillover to the Grid	= 21.27 MW

GSU Transformer	= 31.5/40 MVA (x2)
Proposed GSU Transformer reactance	= 12.5 % @ 31.5 MVA base

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 HSM PP 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

HSM Energy Limited PP would like to go for high pressure cogeneration with the aim of exporting a maximum of 21.27 MW supply to the grid during the Off-Season and 15.08 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 HSM PP 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 Summer 2019 (Off-Season) and Winter 2020 (Crushing Season) after the commissioning of HSM PP in August 2019, 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.
- Months of Summer 2019 and Winter 2020, while representing Off-Season and Crushing Season respectively, also represent high water and low 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.
- Technical system studies for peak load conditions to confirm technical feasibility of the interconnections have been performed. 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.

- Determined the relevant equipment for the proposed technically feasible scheme.
- Recommended the technically most feasible scheme of interconnection.



4. Development of Scheme of Interconnection

4.1 The Existing and Ongoing Network

HSM Energy Limited at Habib Sugar Mills is located in District Nawabshah, embedded in the distribution network of HESCO. The existing 132 kV network available around HSM is shown in Sketch-1 in Appendix-B. The nearest interconnection facilities of HESCO at time of commissioning of HSM would be as follows:

- 132 kV Nawabshah Grid Station
- 132 kV Sanghar Road Grid Station

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 Mirpur Khas 220 kV substations. A strong system helps in stable operation of a power plant.

4.2 The Scheme of Interconnection of HSM PP

Keeping in view of the above mentioned 132 kV network available in the vicinity of the site of the HSM, the interconnection scheme for HSM has been developed. According to the new scheme, it is proposed to connect HSM Energy Limited via looping In-Out of the existing Transmission Line from 132 kV Nawabshah Grid Station to Sanghar Road 132 kV Grid Station. The looping distance as confirmed from site visit would be 0.5 km and the conductor used would be Lynx. The scheme is shown in Sketch-2 in Appendix-B. The network of HSM has been modeled at 132 kV and 11 kV.

5. Detailed Load Flow Studies

This study is carried out for HSM Energy Limited (located in district Nawabshah) in integration with five other newly proposed bagasse based cogeneration power plants in the network of HESCO. Two out of these four PPs, namely Mehran Energy Limited and Tay Powergen (PVT) Ltd. lie in District Tando Allah Yar. Mirpurkhas Energy Limited is located in District Mirpurkhas. Habib Sugar Mills PP is located in Benazir Abad district. Faran Power Limited and Digri Sugar Mills PP are located in District Tando Muhammad Khan. The network around HSM Energy Limited (referred to as HSM PP in the remainder of the report) at 132 kV and 11 kV has been modeled as shown in Appendix-B.

5.1 Peak Load Case Summer 2019, without HSM Energy Limited

A base case has been developed for the peak load of Summer 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 2019-20 for HESCO has been modeled as per the latest PMS Demand forecast obtained from NTDC. It is attached in Appendix-A.

In this scenario, the system is considered without the induction of HSM Energy Limited. 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, Sakrand, Nawabshah, Sanghar Road, Jam Sahib, Shahpur Chakar, Sanghar 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	Sanghar Road to Nawabshah 132 kV Single Circuit Out
Exhibit - 0.2	Jam Sahib to Nawabshah Sangar Road 132 kV Single Circuit Out
Exhibit - 0.3	Sakrand to Nawabshah 132 kV Single Circuit Out
Exhibit - 0.4	Shahpur Chakar to Jam Sahib 132 kV Single Circuit Out
Exhibit - 0.5	Matari to Sakrand 132 kV Single Circuit Out
Exhibit - 0.6	Sanghar to Shahpur Chakar 132 kV Single Circuit Out



For all the outages, the intact circuits remain within their rated limit while the bus voltages are within the acceptable operating range.

5.2 Peak Load Case Summer 2019, with HSM PP in Off-Season

The scheme of interconnection modeled in the load flow for HSM PP is as described in Chapter-4.

Load flow studies have been carried out for summer season because it represents the maximum hydropower dispatch conditions in the grid during the Off-Season for HSM PP. In this scenario all six PPs including Habib Sugar Mills PP are considered. The results of load flow with HSM PP interconnected as per proposed scheme are shown in Appendix-C.

The results of Normal case of Peak Summer 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 $\pm 5\%$ of the nominal.

N-1 contingency analysis has been carried out and the plotted results are attached in Appendix – C as follows;

- Exhibit – 1.1 Habib SM PP 132/11 kV Single Transformer Out
- Exhibit – 1.2 Nawabshah Sangar Road to Habib SM PP 132 kV Single Circuit Out
- Exhibit – 1.3 Habib SM PP to Nawabshah 132 kV Single Circuit Out
- Exhibit – 1.4 Jam Sahib to Nawabshah Sangar Road 132 kV Single Circuit Out
- Exhibit – 1.5 Sakrand to Nawabshah 132 kV Single Circuit Out
- Exhibit – 1.6 Shahpur Chakar to Jam Sahib 132 kV Single Circuit Out
- Exhibit – 1.7 Matiari to Sakrand 132 kV Single Circuit Out
- Exhibit – 1.8 Sanghar to Shahpur Chakar 132 kV Single Circuit Out

For all the outages, the intact circuits remain within their rated limit while the bus voltages are within the acceptable operating range.



5.3 Off-Peak Load Case Summer 2019, with HSM PP in Off-Season

Off-Peak Load Case for the same month of Summer 2019 is studied to test the system under light load conditions after the addition of HSM Energy Limited in the network.

The results of this scenario 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 Habib SM PP 132/11 kV Single Transformer Out
- Exhibit – 2.2 Nawabshah Sangar Road to Habib SM PP 132 kV Single Circuit Out
- Exhibit – 2.3 Habib SM PP to Nawabshah 132 kV Single Circuit Out
- Exhibit – 2.4 Jam Sahib to Nawabshah Sangar Road 132 kV Single Circuit Out
- Exhibit – 2.5 Sakrand to Nawabshah 132 kV Single Circuit Out
- Exhibit – 2.6 Shahpur Chakar to Jam Sahib 132 kV Single Circuit Out
- Exhibit – 2.7 Matiari to Sakrand 132 kV Single Circuit Out
- Exhibit – 2.8 Sanghar to Shahpur Chakar 132 kV Single Circuit Out

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 Winter 2020, with HSM PP in Crushing Season

Load flow studies have been carried out for Winter 2020 because it represents the maximum thermal power dispatch conditions in the grid during the Crushing Season condition for HSM PP. Thus the loading on the lines in the vicinity of HSM PP 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 HSM PP interconnected as per proposed scheme are shown in Appendix-C.

The results of Normal case of this scenario are plotted in Exhibit 3.0. 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 – 3.1 Habib SM PP 132/11 kV Single Transformer Out
- Exhibit – 3.2 Nawabshah Sangar Road to Habib SM PP 132 kV Single Circuit Out
- Exhibit – 3.3 Habib SM PP to Nawabshah 132 kV Single Circuit Out
- Exhibit – 3.4 Jam Sahib to Nawabshah Sangar Road 132 kV Single Circuit Out
- Exhibit – 3.5 Sakrand to Nawabshah 132 kV Single Circuit Out
- Exhibit – 3.6 Shahpur Chakar to Jam Sahib 132 kV Single Circuit Out
- Exhibit – 3.7 Matiari to Sakrand 132 kV Single Circuit Out
- Exhibit – 3.8 Sanghar to Shahpur Chakar 132 kV Single Circuit Out

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.

5.5 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 after addition of generation and other reinforcements in the system as per the generation and transmission plan of NTDC and HESCO.

The results of Normal case of Peak 2021 are plotted in Exhibit 4.0. 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 – 4.1 Habib SM PP 132/11 kV Single Transformer Out
- Exhibit – 4.2 Nawabshah Sangar Road to Habib SM PP 132 kV Single Circuit Out
- Exhibit – 4.3 Habib SM PP to Nawabshah 132 kV Single Circuit Out
- Exhibit – 4.4 Jam Sahib to Nawabshah Sangar Road 132 kV Single Circuit Out
- Exhibit – 4.5 Sakrand to Nawabshah 132 kV Single Circuit Out
- Exhibit – 4.6 Shahpur Chakar to Jam Sahib 132 kV Single Circuit Out
- Exhibit – 4.7 Matiari to Sakrand 132 kV Single Circuit Out
- Exhibit – 4.8 Sanghar to Shahpur Chakar 132 kV Single Circuit Out

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 HSM PP.

5.6 Conclusion of Load Flow Analysis

Different Load flow scenarios were studied for this integrated study of six newly proposed Bagasse based Co-gen Power plants. It is concluded that the proposed interconnection scheme of HSM PP is adequate to evacuate the spillover electrical power from HSM PP under normal and contingency conditions tested for peak and off-peak load conditions of Summer 2019, peak load conditions of Winter 2020 and an 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 HSM PP 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 HSM PP – Year 2019

In order to assess the short circuit strength of the network of 132 kV without HSM PP 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 HSM PP and later on how much the contribution of fault current from HSM PP 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 Daur , Nawabshah and the surrounding bus bars and are shown plotted in the Exhibit 5.0 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 HSM PP - Year 2019

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Daur 132 kV	3.04	1.94
Nawabshah 132 kV	5.58	3.61
Nawabshah Site 132 kV	5.40	3.50
Sakrand 132 kV	7.01	4.63
Saeedabad 132 kV	5.12	3.33
Hala 132 kV	7.37	4.96
Bhit Shah 132 kV	6.65	4.41
Halaroad-1 132 kV	16.57	14.72
Matiari 132 kV	7.29	5.07
Kandari 132 kV	8.81	5.93
Sanghar 132 kV	6.11	4.00
Shahpurc 132 kV	4.20	2.70
Jam Sahib 132 kV	4.16	2.66
Sanghar Road 132 kV	5.22	3.37

6.3 Fault Current Calculations with HSM PP – 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 HSM PP itself and other bus bars of the 132 kV substations in the electrical vicinity of Daurr , Nawabshah and Hala Road. The graphic results showing maximum 3-phase and 1-phase fault levels are indicated in Exhibit 5.1. 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 HSM PP 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 HSM PP – Year 2019

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Habib LV 11 kV	21.34	5.29
Habib SM PP 132 kV	5.43	4.94
Daur 132 kV	3.12	2.30
Nawabshah 132 kV	5.77	5.00
Nawabshah Site 132 kV	5.57	4.60
Sakrand 132 kV	7.19	5.66
Saeedabad 132 kV	5.20	3.61
Hala 132 kV	7.43	5.11
Bhit Shah 132 kV	6.70	4.50
Halaroad-1 132 kV	16.65	14.91
Matari 132 kV	7.34	5.20
Kandari 132 kV	8.85	6.09
Sanghar 132 kV	6.14	4.15
Shahpurc 132 kV	4.22	2.92
Jam Sahib 132 kV	4.17	3.07
Sanghar Road 132 kV	5.19	4.54

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 HSM PP 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 HSM PP 132 kV is 5.43 kA and 4.94 kA for 3-phase and 1-phase faults respectively.

6.4 Fault Current Calculations with HSM PP – 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 at 132 kV bus bars of HSM PP itself and other bus bars of the 132 kV substations in the electrical vicinity of Daur, Nawabshah and Hala Road. The graphic results showing

maximum 3-phase and 1-phase fault levels are indicated in Exhibit 5.2. 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 HSM PP 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 HSM PP – Year 2021

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Habib LV 11 kV	29.96	19.48
Habib SM PP 132 kV	5.88	5.16
Daur 132 kV	3.24	2.33
Nawabshah 132 kV	6.20	5.19
Nawabshah Site 132 kV	5.93	4.74
Sakrand 132 kV	7.57	5.81
Saeedabad 132 kV	5.33	3.66
Hala 132 kV	7.57	5.18
Bhit Shah 132 kV	6.81	4.55
Halaroad-1 132 kV	17.07	15.16
Matiari 132 kV	7.47	5.25
Kandari 132 kV	9.04	6.19
Sanghar 132 kV	6.26	4.20
Shahpure 132 kV	4.33	2.96
Jam Sahib 132 kV	4.33	3.13
Sanghar Road 132 kV	5.58	4.71

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 HSM PP 132 kV is 5.88 kA and 5.16 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 HSM PP 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 HSM PP 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 HSM PP 132 kV is 5.43 kA and 4.94 kA for 3-Phase and 1-phase faults respectively for the year 2019. The same values for the year 2021 are 5.88 kA and 5.16 kA. Therefore, industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of HSM PP 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 = 2.819 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 simulation 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 HSM PP i.e. right at the 132 kV bus bar of HSM PP 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 HSM PP in Year 2019

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 HSM PP 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: HSM PP to N.S.SNGR 132 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. HSM-PP 132 kV 2. Daur 132 kV 3. Nawabshah 132 kV 4. N.S.SNGR 132 kV 5. Jam Sahib 132 kV 6. Sakrand 132 kV	The voltages of all the bus bars recover after fault clearance	1.1
Frequency	HSM PP 11 kV	Recovers after fault clearance	1.2
MW/MVAR Output of the Plant	HSM PP 11 kV	Recovers after damping down oscillations	1.3
Speed and P_{mechanical} of the Plant	HSM PP 11 kV	Recovers after damping down oscillations	1.4
Line Flows (MW/MVAR)	HSM PP to Nawabshah 132 kV single circuit	Attains steady state value after damping of oscillations	1.5
Rotor Angles	1. HSM PP 11 kV 2. MEPKL PP 11 kV 3. MEL 11 kV 4. FPL 11 kV 5. T.A.YAR 11 kV 6. Hub 500 kV (reference angle)	Damps down and attain a steady state value	1.6

7.2.2

Fault Location: Single Phase Fault at HSM PP 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: HSM PP to N.S.SNGR 132 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. HSM-PP 132 kV 2. Daur 132 kV 3. Nawabshah 132 kV 4. N.S.SNGR 132 kV 5. Jam Sahib 132 kV 6. Sakrand 132 kV	The voltages of all the bus bars recover after fault clearance	2.1
Frequency	HSM PP 11 kV	Recovers after fault clearance	2.2
MW/MVAR Output of the Plant	HSM PP 11 kV	Recovers after damping down oscillations	2.3
Speed and $P_{\text{mechanical}}$ of the Plant	HSM PP 11 kV	Recovers after damping down oscillations	2.4
Line Flows (MW/MVAR)	HSM PP to Nawabshah 132 kV single circuit	Attains steady state value after damping of oscillations	2.5
Rotor Angles	1. HSM PP 11 kV 2. MEPKL PP 11 kV 3. MEL 11 kV 4. FPL 11 kV 5. T.A.YAR 11 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 Nawabshah 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Nawabshah to Sakrand 132 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. HSM-PP 132 kV 2. Daur 132 kV 3. Nawabshah 132 kV 4. N.S.SNGR 132 kV 5. Jam Sahib 132 kV 6. Sakrand 132 kV	The voltages of all the bus bars recover after fault clearance	3.1
Frequency	HSM PP 11 kV	Recovers after fault clearance	3.2
MW/MVAR	HSM PP 11 kV	Recovers after	3.3

Output of the Plant		damping down oscillations	
Speed and P_{mechanical} of the Plant	HSM PP 11 kV	Recovers after damping down oscillations	3.4
Line Flows (MW/MVAR)	HSM PP to Nawabshah 132 kV single circuit	Attains steady state value after damping of oscillations	3.5
Rotor Angles	1. HSM PP1 11 kV 2. MPKEL PP 11 kV 3. MEL 11 kV 4. FPL 11 kV 5. T.A.YAR 11 kV 6. Hub 500 kV (reference angle)	Damps down and attain a steady state value	3.6

7.3 Dynamic Stability Simulations' Results with HSM PP in Year 2021

Fault Location: Three Phase Fault at HSM PP 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: HSM PP to N.S.SNGR 132 kV Single Circuit			
Variable	Bus/Line	Response	Figure No.
Voltage	1. HSM-PP 132 kV 2. Daur 132 kV 3. Nawabshah 132 kV 4. N.S.SNGR 132 kV 5. Jam Sahib 132 kV 6. Sakrand 132 kV	The voltages of all the bus bars recover after fault clearance	1.1
Frequency	HSM PP 11 kV	Recovers after fault clearance	1.2
MW/MVAR Output of the Plant	HSM PP 11 kV	Recovers after damping down oscillations	1.3
Speed and P_{mechanical} of the Plant	HSM PP 11 kV	Recovers after damping down oscillations	1.4
Line Flows (MW/MVAR)	HSM PP to Nawabshah 132 kV single circuit	Attains steady state value after damping of oscillations	1.5
Rotor Angles	1. HSM PP11 kV 2. MPKEL PP 11 kV 3. MEL 11 kV 4. FPL 11 kV 5. T.A.YAR 11 kV 6. Hub 500 kV (reference angle)	Damps down and attain a steady state value	1.6



7.4 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 HSM PP. Therefore there is no problem of dynamic stability for interconnection of HSM PP; it fulfills all the criteria of dynamic stability.



8. Conclusions

- ❖ Grid Interconnection Study for 26.34 MW (Gross Capacity) HSM Energy Limited PP has been carried out which is located in District Nawabshah, Sindh. The nearest HESCO grid facility available for interconnection to HSM PP would be Nawabshah 132 kV Grid Station and Sanghar Road 132 kV Grid Station.
- ❖ Keeping in view the location of Power Project, it is proposed to connect HSM Energy Limited via looping In-Out of the existing Transmission Line from 132 kV Nawabshah grid station to Sanghar Road 132 kV grid station. The looping distance as confirmed from site visit would be 0.5 km and the conductor used would be Lynx. The scheme is shown in Sketch-3 in Appendix-B.
- ❖ HSM PP 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. Percentage Reactance of these step-up transformers is proposed to be 12.5% on ONAN base.
- ❖ The proposed scheme would require two 132 kV line bays at the 132 kV substation of HSM for the connection to 132 kV Nawabshah Grid Station and Sanghar Road 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 26.5 MW, the spillover from HSM PP would be 21.27 MW in Off-Season and 15.08 MW in the Crushing Season.
- ❖ In view of planned COD of HSM PP in August 2019, the above proposed interconnection scheme has been tested for steady state conditions through detailed load flow studies for the following scenarios:
 - Peak and Off-Peak Load Conditions of Summer 2019 for maximum hydropower dispatches in the grid during the Off-Season for HSM PP.
 - Peak Load Conditions of Winter 2020 for maximum thermal power dispatches in the grid during the Crushing Season for HSM PP.

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 Summer 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 21.27 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 HSM PP 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 HSM PP.
- ❖ The maximum short circuit levels of HSM PP 132 kV are 5.43 kA and 4.94 kA for 3-phase and 1-phase faults respectively for the year 2019. The same values for the year 2021 are 5.88 kA and 5.16 kA. It would be advisable to go for standard size switchgear of short circuit rating of 40 kA for the 132 kV and 11 kV bus bars at substation of HSM PP. 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 Summer 2019. The stability check for the worst case of three phase fault right on the 132 kV bus bar of HSM PP 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.