[redacted]

APPLICATION

[redacted]

TO

THE REGISTRAR

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

BY

SHEIKHOO POWER (PVT.) LIMITED (SPPL)

FOR

GENERATION LICENSE OF 30 MW NEW BAGASSE BASED HIGH-PRESSURE CO-GENERATION POWER PLANT

AT SHEIKHOO SUGAR MILLS LTD. TEHSIL KOT ADDU, DISTRICT, MUZAFFARGARH, PUNJAB, PAKISTAN.

VOLUME - I

(REGULATION)

SHEIKHOO POWER (Pvt.) LIMITED

Ref No. **SPPL/001/17**
Date: **14/03/2017**

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

SUBJECT: **APPLICATION FOR A GENERATION LICENSE**

I, Yousuf Anis Ahmed, Chief Executive, being the duly Authorized representative of **SHEIKHOO POWER (PVT.)** ***Limited*** **(SPPL)** by virtue of Resolution of Board of Directors dated ***March 6, 2017,*** hereby apply to the National Electric Power Regulatory Authority for the grant of a Generation License to SPPL in pursuant to Section 15 of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

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

Bank Drafts No. ***103118869 & 103118888*** dated ***08/03/2017 & 13/03/2017*** drawn on ***MCB*** Bank Limited, ***Lahore Main MKT, Gulberg,*** Lahore in the sum of Rupees ***Two Hundred Ninety-Three Thousand Seven Hundred Twenty-Eight only*** (***PKR 220,296+73,432=293,728.00***), being the non-refundable license application fee calculated in accordance with Schedule II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, is also attached herewith.

Yours Faithfully,

Yousuf Anis Ahmed
Chief Executive

Index

Authorization from Board Resolution / Power of Attorney

SHEIKHOO POWER (Pvt.) LIMITED

EXTRACTS OF THE RESOLUTIONS OF BOARD OF DIRECTORS OF SHEIKHOO POWER (PVT) LIMITED PASSED IN THEIR MEETING HELD ON MARCH 6, 2017 AT IT'S HEAD OFFICE AT F-11, PHASE 1, COMMERCIAL AREA D.H.A. LAHORE

The Board of Directors of Sheikhoo Power (Pvt.) LIMITED company duly formed and registered in the Islamic Republic of Pakistan under the company's ordinance 1984 having incorporation No. **0099199** and having its registered office at **AMIN BUILDING 65-THE MALL, LAHORE,** in their meeting held on **MARCH 6, 2017**, passed the following resolutions:

UNANIMOUSLY RESOLVED that the Company should approach NEPRA for Generation License under the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.

Further Resolved, that Mr. Yousuf Anis Ahmed, Chief Executive, Mr. **SHAKEEL AHMED SHEIKH**, Company Secretary, of the Company be and are hereby singly authorized to do any or all of the following acts, deeds and things, on behalf of the Company, in connection with this application to be filed with NEPRA under the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 and the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999:

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

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

Company Secretary

Chief Executive / Chairman

A008791

SECP

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE, LAHORE

CERTIFICATE OF INCORPORATION

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

Corporate Universal Identification No.0099199

I hereby certify that SHEIKHOO POWER (PRIVATE) LIMITED is this day incorporated under the Companies Ordinance, 1984 (XLVII of) and that the company is Limited by Shares.

Given under my hand at Lahore this Twenty Sixth day of April, Two Thousand and Sixteen.

CERTIFIED TO BE TRUE COPY

Fee Rs.52,000/-

ADDITIONAL JOINT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE

(SHAUKAT HAMEED)
Joint Registrar

No.ARL/27068 DATED: 26-04-2016

Certified Copies of Memorandum and articles of association

(Certified by SECP)

THE COMPANIES ORDINANCE, 1984

--:o:--

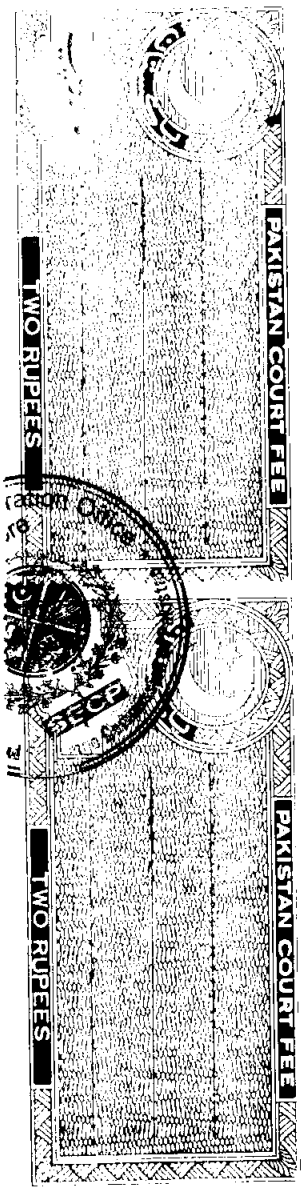
(PRIVATE COMPANY LIMITED BY SHARES)

--:o:--

Memorandum of Association

of

SHEIKHOO POWER (PRIVATE) LIMITED



I. The name of the Company is "**SHEIKHOO POWER (PRIVATE) LIMITED**".

II. The Registered Office of the Company will be situated in the Province of Punjab.

III. The objects for which the Company is established, are all or any of the following:-

1. To develop, design, insure, construct, complete, own, possess, manage, operate and maintain electric power generation plant(s) in Pakistan at such location(s) as the applicable laws/policies permit, and in connection therewith to engage in the business of generation, transmission, sale, supply and distribution of electricity and steam within Pakistan and to do all and everything necessary, suitable, proper, incidental or conducive to the accomplishment of this object and to do every other act or thing incidental or appurtenant to or arising out of or connected with this object, subject to permission from NEPRA, wherever applicable.

2. To carry on and undertake the business of construction and development of power plants in all its forms and perspectives and for that purpose to own or acquire all types of land, building and requisite facilities and to do all such acts, deeds or things as would be required for the effective discharge of this object.

3. To acquire or take on lease or purchase machinery, plant, equipment, spare parts, raw materials, natural fuel, supplies and related goods and services necessary and/or incidental to the development, ownership, construction, management, operation and maintenance of power plant(s).

4. To establish and maintain housing, transportation, communication and utility lines and other requisite logistic facilities for the construction, operation and maintenance of power plant(s).

5. To secure, subject to applicable laws and technical collaboration for the development, ownership, construction, operation and management of power plant(s).

6. To obtain loans, credit and financial facilities in local and/or foreign currency from banks and other financial institutions operating in Pakistan, and subject to necessary approvals under the applicable laws/policies, financing from international sources, proceeds of which are to be used for the development, ownership, construction, operation and maintenance of power plant(s).

7. To mortgage, hypothecate, create charges and other encumbrances on the properties and assets of the Company in such manner and on such terms and conditions as the Company may determine.

8. To enter into any arrangement or agreement with purchasers of power from the power plant(s).

9. To enter into contracts for the purchase of fuel for the power plant(s), for construction of the power plant(s), for operation and maintenance of the same and other agreements as may be necessary in the conduct and furtherance of business of the Company and to take all actions before competent forums for the enforcement of such agreements and contracts.

10. To take out any insurance that the Company deems necessary or appropriate in connection with the ownership, construction, operation and maintenance of power plant(s) and to pay the premium thereof.

11. To enter into any arrangement with, obtain consents and approvals of, secure interim and final orders from the Government of Pakistan, and any other governmental agency or body and to undertake efforts to promote or modify laws, regulations and policies, and where required, to seek like dispensation from any government or public authority or any corporation or private persons, or any foreign government, authority or person to further the development, ownership, construction, management, operation or maintenance of power plant(s) and to oppose by legal means within or outside Pakistan any actions or measures as are taken by any governmental or other authority which the Company considers likely to adversely affect the development, ownership, construction, management, operation or maintenance of power plant(s) and to obtain or endeavor to obtain from any governmental or other public authority anycharters,

12. To operate, maintain and manage power generation facilities, power stations, power houses and grid stations together with all machinery, equipment and works ancillary thereto and plan, survey, design, supply equipment and to do all such acts, deeds and things, without limitation whatsoever, as may be necessary or desirable in furtherance of the exclusive object for which the Company has been incorporated, subject to permission from NEPRA.

13. To carry on the business as engineers, designers, architects, operators, concessionaries, surveyors (except insurance surveyor), builders, masonry and general construction contractors, erectors and to establish, operate, manage, maintain, equip, construct, repair, renovate, improve, work on, industrial,, commercial and residential buildings, parks, roads, motorways, highways, playlands, stadiums, gymnasiums, railways, roadways, airports, runways, docks, harbors, wharves, canals, water courses, reservoirs, embankments, irrigations, reclamations,

sewerages, drainage and other sanitary works and systems, water, gas, electric and other supply works, godowns, mills, factories, installation and related or other works of all kinds and description and to equip the same or any part thereof with all or any conveniences and utilities which include, but are not limited to, electricity, gas, telephone, internet, drainage and sewage facilities and to do all such acts, deeds or things as would be required for effective discharge of these objects.

14. To carry on the business of estimation, drawing up of specifications and contracts, quantity surveying, supervision and execution of construction works and all installation and maintenance thereof.

15. To equip and furnish any property for the purpose of letting or hiring the same to visitors as guests whether in single or double rooms, suites, chalets, cottages or otherwise.

16. To carry on and undertake trading business of all sorts and to act as indentors, importers, exporters, traders, suppliers and commission agents of products, commodities and materials in any form or shape manufactured or supplied by any company, firm, association of person body, whether incorporated or not, individuals, government, semi-government or any local authority, as permissible under law.

17. To apply for, tender, offer, accept, purchase or otherwise acquire any contracts and concessions for or in relation to the projection, execution, carryout out, improvements, management, administrations or control of works and conveniences and to undertake, execute, carry out, dispose of or otherwise turn to account the same.

18. To carry on all or any of the business as manufacturers, buyers, sellers, indentors, importers, exporters, distributors, agents, factors, stockists, commission agents and dealers of engineering goods, machine tools, hand tools, small tools, metals, alloys, iron pipe fittings, nuts and bolts, bicycles and accessories, automobile parts, steel and stainless steel and iron products, cutleries, ores, and scraps.

19. To carry on agency business (except managing agency) and to acquire and hold selling agencies and to act as general agents, selling agents, mercantile agents, commission agents, carrier's agents, shipping agents, clearing and forwarding agents, indenting agents, advertisers, stockists, manufacturers' representative and distributing agents of and for the distribution of all kinds of local and foreign merchandise, goods, commodities, products, materials, substances, articles and things whether finished, semi-finished, raw, under process, refined, treated or otherwise pertaining to trade and commerce and for that purpose to remunerate them and to open and maintain depots and branches.

20. To build, construct, alter, maintain, enlarge, pull down, remove or replace; to work, manage and control; to develop any property acquired, purchased or owned by the Company or any other company including buildings, offices, mills, ware-houses, shops, stores, machineries, roads, railways, bridges, reservoirs, watercourses, wharves, electric works, industrial and commercial concerns and other works and conveniences in furtherance of its objects and to perform professional engineering work or enter into agreements with the companies performing professional engineering work.

21. To act as representatives, for any local or foreign person, firm or company and to undertake and perform sub-contracts, and also act in the business of the Company through or by means of agents, sub-contractors and to do all or any of the things mentioned herein in any part of the world and either alone or in collaboration with others and by or through agents, sub-contractors or otherwise.

22. To enter into agreement(s) with any government or authority (foreign, supreme, municipal, local or otherwise) or any corporation, company or persons that may seem conducive to the Company's objects or any of them and to obtain from any such government, authority, corporation, company or person any charters, contracts, rights, privileges and commission which the Company may think desirable and to carry on exercise and comply with any such charters, contracts, decrees, rights, privileges and concessions.

23. To apply for and obtain necessary consents, permissions and licences, rights, privileges and concessions from any local or foreign Government, State, Municipal, Local and other authorities or persons for enabling the Company to carry on its objects and to oppose any proceedings or application which may seem calculated directly or indirectlyto prejudice the interests of the Company.

24. To, subject to the approval of the competent authority, make, amend and modify Articles of Association and rules and regulations not inconsistent with this Memorandum of Association to provide for all matters for which provision is necessary or expedient for the purpose of giving effect to the provisions of this Memorandum of Association and the efficient conduct of its objects.

25. To adopt such means of making known the Company as may seem expedient and in particular by advertising in the media, by circulars, by purchase and exhibition of works of art or interests, by publication of books and periodicals and by granting prizes, rewards and donations.

26. To appoint agents, sub-agents, attorneys, consultants, and contractors or to act as agent, sub-agent, attorney, consultant, and contractor in connection with the objects of the Company but not to act as managing agents.

27. To borrow or raise money in such manner as the Company shall think fit in pursuance of its objects, and in particular by the issue of debentures, or debenture stock (perpetual or otherwise), Participation Term Certificates, Term Finance Certificates or otherwise and by issue of all securities including securities not based on interest for raising redeemable capital, resource funds from banks or financial institutions and by issue of shares in lieu of outstanding balance of any loan and by issue of securities as required by the rules and regulations of the banks, financial institutions and loan giving agencies and to secure the repayment of any money borrowed, raised or owing by mortgage, charge or lien upon all or any of the property or assets of the Company (both present and future).

28. To sell, improve, manage, develop, exchange, mortgage, enfranchise, dispose of or otherwise deal with, all or any part of the property, assets or undertaking of the Company for such consideration as the Company may think fit and if required in event of winding up of Company.

29. To accept or give security, including but not limited to promissory notes, indemnity bonds, guarantees, assignments, receipts, bailments, pledges, hypothecations, liens, mortgages and charges, against the credit extended or moneys borrowed in connection with its objects.

30. To employ and remunerate managers and other officers, employees and servants of the Company or any person or firm or company rendering services to the Company upon such terms as the Company may determine.

31. To establish and maintain or procure the establishment and maintenance of any contributory or non-contributory pension, superannuation funds for the benefit of, and give or procure the giving of donations, gratuities, pensions, allowances or emoluments to any person who are or were at any time in the employment or service of the Company, or who are or were at any time directors or officers of the Company and the wives, widows, families and dependents of any such persons, and also to establish and subsidise and subscribe to any institutions, associations, clubs or funds calculated to be for the benefit of or to advance the interest and well-being of the Company.

32. To enter into a joint venture or a partnership or cooperation with any person or company or other legal entity, local or foreign, or otherwise assist any such person or company or legal entity in furtherance of its objects.

33. To pay out of the funds of the Company all expenses of and incidental to the formation, registration, advertisement of the Company and the issue and subscription of the share or loan capital or placing or guaranteeing the placing of shares or any debentures, debenture-stock and other securities of this Company and also all expenses relating to the issue of any circular or notice and the printing, stamping, circulating of proxies and forms to be filled up by the members of the Company.

34. To insure the property, assets, and employees of the Company in any manner deemed fit by the Company, and to create any reserve funds, sinking fund, insurance fund or any other special fund whether for depreciation or for repairing, insuring, improving, extending or maintaining any of the property of the Company or for any other purpose conducive to its objects but not to act as an insurance company.

35. To subscribe for, take or otherwise acquire and hold shares, debentures or securities of any other company having objects altogether or in part similar to those of this Company or carrying on any business capable of being conducted so as directly or indirectly to benefit this Company and to invest the moneys not immediately required for the business of the Company in, and to hold, sell the stocks, shares, bonds, debentures, debenture stocks, PTCs, TFCs, mutual fund certificates, NIT units, Modaraba certificates or certificates of investment obligations, notes and

securities of any Government, Province, company, Corporation, Municipal or Local or other Body or Authority and to deal with the monies of the Company for such purposes conducive to the interest of the Company and to vary investments from time to time but not to act as an investment company.

36. To receive, declare and distribute profits and to capitalize such portion of the profits of the Company as are not distributed among shareholders of the Company in the form of dividends, and as the Directors of the Company may think fit, and to issue bonus shares, as fully paid up, in favour of the shareholders of the Company.

37. To subscribe or contribute or otherwise to assist or to guarantee money to charitable, benevolent, religious, literary, scientific, technical, national, public or any other institutions or for any exhibition or purpose.

38. To file or register any document required to be filed or registered under law, and to pay any fees, charges, expenses, rents, taxes, duties and other dues payable in connection with its objects.

39. To settle disputes by negotiation, reconciliation, arbitration, litigation or other means and to enter into compromise with creditors, members and any other persons in respect of any difference or dispute with them.

40. To establish laboratories, research and development centres to perform such research and development as the Company may deem advisable or feasible, and to expend money on experimenting upon and testing and improving or securing any process, or processes, patent or protecting any invention or inventions which the Company may acquire or propose to acquire or deal with in furtherance of its objects.

41. To develop and/or transfer technology and to acquire or pass on technical know-how incidental or conducive to the attainment of its objects.

42. To train personnel and workers, both in Pakistan and abroad to obtain technical proficiency in various specialties connected with its objects.

43. To do all such other things as may be deemed incidental or conducive to the attainment of the main objects or any of them in any part of the world, and as principals, agents, contractors, trustees or otherwise, and by or through trustees, agents or otherwise and either alone or in conjunction with others.

44. To purchase, take on lease or in exchange, hire, apply for or otherwise acquire and hold for any interest, any rights, privileges, lands, building, easements, trademarks, patents, patent rights, copyrights, licences, machinery, plants, stock-in-trade and any movable and immovable property of any kind necessary or convenient for the purposes of or in connection with the Company's business or any branch or department thereof and to use, exercise, in respect of or otherwise turn to account any property, rights and information so acquired, subject to any permission required under the law.

45. To acquire by concession, grant, purchase, barter, licence either absolutely or conditionally and either solely or jointly with others any lands, buildings, machinery, plants, equipments, privileges, rights, licences, trade marks, patents, and other movable and immovable property of any description which the Company may deem necessary or which may seem to the Company capable of being turned to account, subject to any permission as required under the law.

46. To enter into arrangements with the government or authority (supreme, municipal, local or otherwise) or any corporation, company or persons that may seem conducive to the Company's objects or any of themand to obtain from any such government, authority, corporation, company or person any charters, contracts, rights, privileges and commission which the Company may think desirable and to carry on exercise and comply with any such charters, contracts, decrees, rights, privileges and concessions.

47. To open, close and operate bank accounts of the Company with any bank or banks, financial institutions or co-operative societies and to draw, make, accept, endorse, discount, execute and issue promissory notes, bills of exchange, bills of lading, warrants, debentures and other negotiable or transferable instruments, but not to act as a finance or banking company.

48. To arrange local and foreign currency loans from scheduled banks, industrial banks and financial institutions for the purpose of purchase, manufacture, market, supply, export and import of machinery, construction of factory, building and for the purpose of working capital or for any other purpose.

49. To sell or otherwise dispose of the whole or any part of the undertaking of the Company, either together or in portions for such consideration as the Company may think fit and in particular, for shares, debenture-stock or securities of any Company purchasing the same.

50. To borrow money by means of loans or other legal arrangements from banks, or other financial institutions, or Directors in such manner as the Company may think fit and in particular by issue of debentures, debenture stock, perpetual or otherwise convertible into shares and to mortgage, or charge the whole or any part of the property or assets of the Company, present or future, by special assignment as may seem expedient and to purchase, redeem or pay off any such securities.

51. To distribute any of the Company's property and assets among the members in specie or in any manner whatsoever in case of winding up of the Company in the event of winding up of Company.

52. To guarantee the performance of contracts and obligations (including payment of loans) of any person providing goods or services in connection with the construction, operation or maintenance of power plant(s) or purchasing electricity generated by power plant(s) but not in any event to carry on the business ofbanking.

53. To carry out joint venture agreements with other companies or countries within the scope of the objects of the Company.

54. To cause the Company to be registered or recognised in any foreign country.

55. To do and perform all other acts and things as are incidental or conducive to the attainment of the above objects or any of them.

56. To apply for and obtain necessary consents, permissions and licences from any Government, State, Local and other Authorities for enabling the Company to carry on any of its objects into effect as and when required by law.

57. 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.

58. It is declared that notwithstanding anything contained in the foregoing object clauses of this Memorandum of Association nothing contained therein shall be construed as empowering the Company to undertake or to indulge in business of payment systems, Electronic funds transfers in and outside Pakistan, deposit taking from general public, network marketing, referral marketing & direct selling banking company, leasing, investment, managing agency, insurance business, any of the NBFC business, multi-level marketing (MLM), Pyramid and Ponzi Scheme, commodity, future contract or share trading business locally or internationally, directly or indirectly as restricted under the law or any unlawful operation.

IV. The liability of the members is limited.

V. The Authorised Capital of the Company is Rs. 10,000,000/- (Rupees Ten Million only) divided into 100,000 ordinary shares of Rs. 100/- (Rupees One Hundred only) each with powers to the company from time to time to increase and reduce its capital subject to any permission required under the law.

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

Name and Surname (Present & Former) in Full (in Block Letters) and C.N.I.C. #	Father's Name (in Full)	Nationality with any former Nationality	Occupation	Residential Address (in Full)	Number of shares taken by each subscriber	Signature
1. SHEIKHOO SUGAR MILLS LIMITED	-	Pakistani	Manufacturing of Sugar	Amin Building 65-The Mall, Lahore.	97 Ninety Seven	
Through its Nominees MR. YOUSUF ANIS AHMED C.N.I.C. # 35201-1179115-1	*S/o* Anis Ahmed	Pakistani	Business	House No. 96 - Y, St. No. 18, Phase 3, Defence Housing Authority, Lahore - Cantt.	1 One	
MR. FAISAL IDREES C.N.I.C. # 35201-2101641-5	*S/o* Idrees Ahmed	Pakistani	Business	House No. 44-L, Defence Housing Authority, Lahore - Cantt.	1 One	
MR. OSMAN AZIZ ANWAR C.N.I.C. # 35201-7919236-9	*S/o* Aziz A Anwar	Pakistani	Business	House No. 277/r, Phase II, Defence Housing Authority, Lahore - Cantt.	1 One	
				Total Number of Shares Taken	100 One Hundred	

CERTIFIED TO BE TRUE COPY
13/4/2016
ADDITIONAL JOINT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE

Dated this 25th day of April, 2016.

Witness:

National Institutional Facilitation Technologies (Pvt.) Ltd
5th Floor, AWT Plaza,
I. I. Chundrigar Road,
Karachi.

THE COMPANIES ORDINANCE, 1984

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(PRIVATE COMPANY LIMITED BY SHARES)

-- : o : --

Articles of Association

of

SHEIKHOO POWER (PRIVATE) LIMITED

PRELIMINARY

1. Subject as hereinafter provided, the Regulations contained in Table 'A' of t First Schedule to the Companies Ordinance, 1984, (hereinafter referred to as Table 'A') sh apply to the Company so far as those are applicable to Private Companies, with t exception of the Regulations which are modified, altered or added hereunder.

PRIVATE LIMITED COMPANY

2. The Company is a Private Company within the meaning of Clause (28) of Secti 2(1) of the Companies Ordinance, 1984 and accordingly:-

(a) No invitation shall be issued to the public to subscribe for any shar debentures or debenture-stocks of the Company;

(b) The number of members of the Company (exclusive of persons in employment of the Company) shall be limited to fifty provided that for purpose of this provision when two or more persons hold one or m shares in the Company jointly they shall for the purposes of this clause treated as a single member ; and

(c) The right to transfer shares in the Company is restricted in the manner a to the extent hereinafter appearing.

BUSINESS

3. The Company is entitled to commence business from the date of incorporation.

4. The business of the Company shall include all or any of the objects enumera in the Memorandum of Association.

5. The business of the Company shall be carried out at such place or places in whole of Pakistan or elsewhere as the Directors may deem proper or advisable from tim time.

CAPITAL

6. The Authorized Capital of the Company is Rs. 10,000,000/- (Rupees Ten Million only) divided into 100,000 ordinary shares of Rs. 100/- (Rupees One Hundred only) each with powers to increase, reduce, consolidate, sub-divide or otherwise reorganize the share capital of the Company.

7. The shares shall be under the control of the Board of Directors who may allot or otherwise dispose of the same to such persons, firms, corporation or corporations on such terms and conditions and at any such time as may be thought fit.

8. The shares in the capital of the Company may be allotted or issued in payment of any property, land, machinery or goods supplied or any services rendered to the Company or promotion or formation of the Company or conduct of its business and any shares so allotted may be issued as fully paid shares.

SHARES, TRANSFER AND TRANSMISSION

9. Every person whose name is entered, as a member in the Register of Members shall without payment be entitled to a certificate under the Common Seal of the Company specifying the shares held by several persons. The Company shall not be bound to issue more than one certificate and delivery of a share certificate to any one of several joint holders shall be sufficient delivery to all.

10. The Directors may decline to register any transfer of share to transferee of whom they do not approve and shall be bound to show any reasons for exercising their discretion subject to the provisions of Sections 77 and 78 of the Companies Ordinance, 1984.

11. No share can be mortgaged, pledged, sold, hypothecated, transferred or disposed off by any member to a non-member without the previous sanction of the Board of Directors.

12. The legal heirs, executors or administrators of a deceased holder shall be the only persons to be recognized by the Directors as having title to the shares. In case of shares registered in the name of two or more holders the survivors and the executors of the deceased shall be the only persons to be recognized by the Company as having any title to the shares.

GENERAL MEETING

13. The First Annual General Meeting shall be held within 18 months from the date of incorporation of the Company in accordance with the provisions of Section 158 and thereafter once at least in every year and 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 as may be determined by Directors. The Directors may, whenever they think fit, call an Extraordinary General Meeting of the shareholders in terms of Section 159 of the Companies Ordinance, 1984.

PROCEEDINGS AT GENERAL MEETING

14. Twenty one days' notice at least specifying the place, day and hour of the General Meeting and in case of special business the general nature of such business, shall be given to the members in the manner provided in Table "A" but accidental omission to give such notice to or non-receipt of such notice by the member shall not invalidate the proceedings of the General Meeting.

15. The Chief Executive, with the consent of a meeting at which quorum is present and shall if so directed by the meeting may adjourn the 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 the meeting from which the adjournment took place.

QUORUM

16. No business shall be transacted at any General Meeting unless a Quorum of members is present at the time when the meeting proceeds to business. Two members, present in person or as proxies, shall form a Quorum for a General Meeting.

VOTES OF MEMBERS

17. At any General Meeting a resolution put to the vote of the General Meeting shall be decided on a show of hands, unless a poll is demanded in accordance with the provisions of Section 167 of the Companies Ordinance, 1984.

18. On a show of hands every member present shall have one vote and on a poll, every member present in person or by proxy shall have one vote in respect of each share held by him.

19. The instrument appointing a proxy and the power of attorney or other authority under which it is signed or notarially certified copy of that power of attorney or authority shall be deposited at the Registered Office of the Company 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 will not be treated as valid.

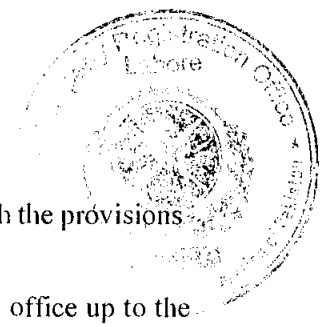
CHIEF EXECUTIVE

20. The first Chief Executive of the Company will be appointed by the Board of Directors within fifteen days from the date of incorporation of the Company who shall hold office till the first Annual General Meeting.

DIRECTORS

21. Unless otherwise determined, the number of Directors shall not be less than two. The following will be the first Directors of the Company:

1. **YOUSUF ANIS AHMED**
2. **FAISAL IDREES**
3. **OSMAN AZIZ ANWAR**



22. The election of the Directors shall be held in accordance with the provisions of Section 178 of the Companies Ordinance, 1984.

23. The first Directors including the Chief Executive shall hold office up to the First Annual General Meeting in accordance with the provisions of the Companies Ordinance, 1984, unless any one of them resigns earlier or becomes disqualified for being Director or otherwise ceases to hold office.

24. A resolution for removing a Director shall not be deemed to have been passed if the number of votes against him is equal to, or less than the number of votes that would have been necessary for the election of Directors at the immediately preceding annual election of Directors in the manner aforesaid but as provided under Section 181 of the Companies Ordinance, 1984.

25. The remuneration of Directors except regularly paid Chief Executive and full time working Directors shall, from time to time, be determined by the Board of Directors but it shall not exceed Rs. 500/- per meeting at which the Directors are present.

26. The Directors may sanction the payment of such additional sums as they may think fit to any Director for any special service he may render to the Company or be thought capable of rendering either by fixed sum or in any other form as may be determined by the Directors subject to the provisions of the Companies Ordinance, 1984.

27. The Director who resides out of station shall also be entitled to be paid such traveling and other expenses for attending the meeting for the Company as may be fixed by the Directors from time to time according to the provisions of the Companies Ordinance, 1984.

28. Any casual vacancy occurring on the Board of Directors shall be filled in by a resolution of the Board of Directors and the person so appointed shall hold office for the remainder of the term of the Directors in whose place he is appointed.

29. No Director shall be disqualified from his office by contracting with the Company either as vendor, purchaser or otherwise nor shall any Director be liable to account for any profit realized from any such contract or arrangement or the fiduciary relation thereby established, but the nature of his interest must be disclosed by him at the first meeting of the Directors after acquisition of his interest.

NOMINEE DIRECTOR

30. In addition to the elected Directors, the Financial Institutions shall be entitled, during the currency of their respective loan(s) to the Company to appoint one person on the Board of Directors of the Company to be called Nominee Director and to recall and/ or replace such a person from time to time. Such Nominee Director on the Board of Directors of the Company may not be holders of share(s) in the Capital of the Company and regulations and/or rules pertaining to the election, retirement, qualification and/or disqualification of Directors shall not apply to him.

NOTICES

31. Notices for every meeting of the Board of Directors will be given in writing and there must be given a reasonable time in advance. The nature of the business to be transacted at an intended Board meeting will be specified in the notice.

MANAGEMENT

32. The whole business and affairs of the Company shall, subject to the control and supervision of the Board of Directors, be managed and controlled by the Chief Executive.

33. Subject to the limit fixed by the Directors, the Chief Executive may from time to time raise or borrow any sums of money for and on behalf of the Company from other companies, banks or financial institutions on such terms as may be approved by the Board of Directors from time to time.

34. Without prejudice to the powers conferred by these Articles, the Board of Directors shall have the following powers :-

(a) To take on lease, purchase, erect or otherwise acquire for the Company any assets, stocks, lands, buildings, 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.

(b) To let, mortgage, sell, exchange or otherwise dispose of absolutely or conditionally all or any part of the assets, stocks, raw materials, properties, privileges and undertaking of the Company upon such terms and conditions and for such consideration as they think fit.

(c) To appoint any person or persons to be attorney or attorneys of the Company for such purposes and with such powers, authorities and

discretions and for such period and subject to such conditions as they may, from time to time, think fit.

(d) To enter into, carry out, rescind or vary all financial arrangements with any bank, person, company, firm or corporation or in connection with such arrangements to deposit, pledge or hypothecate property of the Company or the documents representing or relating to the same.

(e) To make and give receipts, release and discharge all moneys payable to the Company and for the claims and demands of the Company.

(f) To compound or allow time to the payment or satisfaction of any debt due to or by the Company and any claim and demands by or against the Company and to refer claims or demands by or against the Company to arbitration and observe and perform the awards.

(g) To institute, prosecute, compromise, withdraw or abandon any legal proceedings by or against the Company or its affairs or otherwise concerning the affairs of the Company.

(h) To raise and borrow money from time to time for the purposes of the Company, on the mortgage of its property or any part thereof and/or on any bond or debenture payable to bearer otherwise repayable in such a manner and generally upon such terms as they think fit.

(i) To open, operate and maintain bank/banks account(s) individually or jointly as the Board may authorize or to any other person on its behalf.

BORROWING POWERS

35. The Directors may from time to time raise, borrow or secure the payment any sums for the purposes of the Company in such manner and upon such terms and conditions as they think fit and in particular by the issue of debentures, debenture-stock or other securities charged upon all or any part of the property of the Company present or future.

36. Debentures, debenture-stock, or other securities may be issued with any special privileges as to redemption, surrender, allotment of shares, attending and appointment of Directors or other privileges subject to any permission required by law.

THE SEAL

37. The Company shall have a Common Seal and the Directors shall provide for the safe custody of the same. The Seal shall not be applied on any instrument except by the authority of the Board of Directors and in the presence of at least two Directors who shall sign every instrument to which the Seal shall be affixed in their presence. Such signatures shall be conclusive evidence of the fact that the Seal has been properly affixed.

ACCOUNTS

38. The Directors shall cause to be kept proper books of account as required under Section 230 of the Companies Ordinance, 1984.

39. The books of account shall be kept at the registered office of the Company or at such other place as the Directors shall think fit subject to the provisions of Section 230 of the Companies Ordinance, 1984.

AUDIT

40. Once at least in every year the accounts of the Company shall be audited and correctness of the Balance Sheet shall be ascertained by one or more Auditors. The Auditors shall be appointed and their duties regulated in accordance with the provisions of Section 252 to 255 of the Companies Ordinance, 1984.

INDEMNITY

41. In connection with carrying on the business of the Company, the Chief Executive, every Director, or other officers of the Company shall be indemnified by the Company for all losses and expenses occasioned by error of judgment or oversight on his part, unless the same happens through his own dishonesty or willful act and defaults.

SECRECY

42. No member shall be entitled to visit and inspect the Books of the Company without the permission of the Chief Executive or one of the Directors or to require discovery of any information regarding any detail of the Company's business or any matter which is or may be in the nature of trade secret, or secret process which may relate to the conduct of the Company's business and which in the opinion of the Directors, will not be in the interest of the members of the Company to communicate to the public.

DISPUTE RESOLUTION

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

ARBITRATION

44. Whenever any difference arises between the Company on the one hand and the members, their executors, administrators or assignee on the other hand, touching the true intent or construction or the incident or consequence of these present or of the statutes or touching any thing thereafter done, executed, omitted or suffered in pursuance of these presents or otherwise relating to these presents or to any statutes affecting the Company, every such difference shall be referred for the decision of the arbitrator.

45. The cost incidental to any such reference and award shall be at the discretion of the arbitrator or umpire respectively who may determine the amount thereof and direct the same to be shared between the attorney and client or otherwise and may award by whom and in what manner the same shall be borne and paid.

WINDING UP

46. If the Company is wound up whether voluntarily or otherwise the liquidator may, with the sanction of a special resolution, divide amongst the contributories in specie any part of the assets and liabilities of the Company, subject to Section 421 and other provisions of the Companies Ordinance, 1984 as may be applicable.

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

Name and Surname (Present & Former) in Full (in Block Letters) and C.N.I.C. #	Father's Name (in Full)	Nationality with any former Nationality	Occupation	Residential Address (in Full)	Number of shares taken by each subscriber	Signature
1. SHEIKHOO SUGAR MILLS LIMITED	-	Pakistani	Manufacturing of Sugar	Amin Building 65-The Mall, Lahore.	97 Ninety Seven	
Through its Nominees MR. YOUSUF ANIS AHMED C.N.I.C. # 35201-1179115-1	*S/o* Anis Ahmed	Pakistani	Business	House No. 96 - Y, St. No. 18, Phase 3, Defence Housing Authority, Lahore - Cantt.	1 One	
MR. FAISAL IDREES C.N.I.C. # 35201-2101641-5	*S/o* Idrees Ahmed	Pakistani	Business	House No. 44-L, Defence Housing Authority, Lahore - Cantt.	1 One	
MR. OSMAN AZIZ ANWAR C.N.I.C. # 35201-7919236-9	*S/o* Aziz A Anwar	Pakistani	Business	House No. 277-r, Phase II, Defence Housing Authority, Lahore - Cantt.	1 One	
				Total Number of Shares Taken	100 One Hundred	

CERTIFIED TO BE TRUE COPY
ADDITIONAL JOINT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
LAHORE

Dated this 25th day of April, 2016.

Witness:

National Institutional Facilitation Technologies (Pvt.) Ltd
5th Floor, AWT Plaza,
I. I. Chundrigar Road,
Karachi.

PARTICULARS OF DIRECTORS AND OFFICERS, INCLUDING THE CHIEF EXECUTIVE, MANAGING AGENT, SECRETARY, CHIEF ACCOUNTANT, AUDITORS AND LEGAL ADVISERS, OR OF ANY CHANGE THEREIN

THE COMPANIES ORDINANCE, 1984 **FORM 29**

[SECTION 205]

1. Incorporation Number: 0099199
2. Name of Company: SHEIKHOO POWER (PVT.) LIMITED
3. Fee Paid (Rs.): 600.0 Name and Branch of Bank: LAHORE, MCB - Mozang Road [1210]
4. Receipt No.: E-2016-450471 14/05/2016
5. Mode of Payment (Indicate): Bank Challan
6. **Particulars*:**

6.1. New Appointment/Election

Present Name in Full (a)	NIC No. or Passport No. in case of Foreign National (b)	Father / Husband Name (c)	Usual Residential Address (d)	Designation (e)	Nationality** (f)	Business Occupation *** (if any) (g)	Date of Present Appointment or Change (h)	Mode of Appointement / change / any other remarks (i)
Yousuf Anis Ahmed	3520111791151	Anis Ahmed	96-Y, St # 18, Phase 3, DHA, Lahore Cantt. Lahore Punjab Pakistan 54000	Chief Executive	Pakistan	Business	10/05/2016	Appointed
Shakeel Ahmed Sheikh	3520293603329	Muhammad Sarwar Sheikh	House No. 1022-H, Canal View Co-Operative Housing Society, Block-C, Lahore.	Secretary	Pakistan		10/05/2016	Appointed
Dilair Usman Bhatti	3520240593191	Bashir Ahmed Bhatti	House No. 300 J-2, Wapda Town, Lahore.	Chief Accountant	Pakistan		10/05/2016	Appointed
Muhammad Saeed	3520135370875	Muhammad Idrees	4-Rehman Street Old Anarkali, Lahore.	Legal Adviser	Pakistan		10/05/2016	Appointed
Kreston Hyder Bhimji and Co. Chartered Accountants			Amin Building 65-The Mall Road, Lahore	Auditor	Pakistan		10/05/2016	Appointed

6.2. Ceasing of Officer/Retirement/Resignation

Present Name in Full (a)	NIC No. or Passport No. in case of Foreign National (b)	Father / Husband Name (c)	Usual Residential Address (d)	Designation (e)	Nationality** (f)	Business Occupation *** (if any) (g)	Date of Present Appointment or Change (h)	Mode of Appointement / change / any other remarks (i)

6.3 Any other change in particulars relating to columns (a) to (g) above

Present Name in Full (a)	NIC No or Passport No in case of Foreign National (b)	Father / Husband Name (c)	Usual Residential Address (d)	Designation (e)	Nationality** (f)	Business Occupation *** (if any) (g)	Date of Present Appointment or Change (h)	Mode of Appointement / change / any other remarks (i)
Faisal Idrees	3520121016415	Idrees Ahmed	House No. 44-L, DHA, Lahore. Lahore Punjab Pakistan 54000	Director	Pakistan	Business	26/04/2016	Other Change
Osman Aziz Anwar	3520179192369	Aziz A Anwar	H No 277/r, Phase II, DHA, Lahore Cantt Lahore Punjab Pakistan 54000	Director	Pakistan	Business	26/04/2016	Other Change
Yousuf Anis Ahmed	3520111791151	Anis Ahmed	96-Y, St # 18, Phase 3, DHA, Lahore Cantt Lahore Punjab Pakistan 54000	Director	Pakistan	Business	26/04/2016	Other Change

Name of Signatory	Yousuf Anis Ahmed	Designation	Director
Signature of Chief Executive/Secretary		Date (DD/MM/YYYY)	14/05/2016

CERTIFIED TO BE TRUE COPY
13/02/17
ADDITIONAL JOINT REGISTRAR OF COMPANIES
COMPANY REGISTRATION OFFICE
FORM 29 LAHORE

Prospectus

Introduction of Applicant

Sheikhoo Sugar Mills Limited (SSML) is a public (unlisted) Limited company located at Pati Naich, Anwar Abad, Tehsil Kot Addu, District Muzaffar Garh. The SSML is engaged in the manufacturing and sale of sugar and its allied products.

The company proposes to put up a 30MW bagasse fired cogeneration under the policy Framework for Power-Cogeneration 2013 for bagasse / Bio Mass to include bagasse/ biomass under the ambit of the Renewable Energy Policy, 2006. Sugar Mills have been involved in co-generation for decades and are well versed with the process. The plant shall be based on the Bagasse as the sole fuel. Bagasse shall be fired into high pressure boilers to produce steam, which shall be used to generate 30MW electricity. The generation shall be used partly to meet the requirement of the sugar mill, while the spillover shall be sold to the Grid.

A new company, being the 100% subsidiary of Sheikhoo Sugar Mills Ltd., has been formed to put up the new Co-generation plant. The name of the company is Sheikhoo Power (Pvt) Ltd.

Salient Features of The Facility for which license is sought

The parameters of the Project are as under:

Project Capacity	30MW
Project Location	Pati Naich, Anwar Abad, Tehsil Kot Addu, District Muzaffar Garh.
Land Area	Approximately 5 Acre
Construction Period	24 Months
Technology	Bagasse/ Bio-Mass
Power Purchaser	MAPCO
Steam Turbine	30MW Extraction Cum Condensing
Boilers	150 TPH, 110 Bar 540° C
Upfront Levelized Tariff	10.41 PKR/kWh

SHEIKHOO POWER (PVT) LTD. F-11 Phase I SIIA, LHR

Proposed Investment

The total cost for the project is approximated PKR 3907.904 Million (USD 34.892 million).

Social and Environmental Impact of the Proposed Facility

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

Profile of experience of the applicant its management, staff and its members in power sector.

&

CVs of applicant's Senior Management and Technical professionals

Brief History of the Sheikhoo Sugar Mills Ltd.

Company Profile

The company was incorporated as a public limited company on January 03, 1990 under the Companies Ordinance, 1984. The sponsors have contributed the entire equity through 100% investment in foreign exchange.

➢ *Location*

The project has been set-up at Muzaffargarh, Punjab. The site enjoys all infrastructure facilities, i.e., quick & fast transport, communication facilities, raw material, availability of skilled and unskilled labour. The availability of raw material i.e. sugar cane has increased manifold during last sixteen years due to courtant sugar cane development efforts by Sheikhoo Sugar Mills Limited (SSML).

➢ *Plant & Machinery*

The Plant & Machinery of the mills is a mix of local and imported machines. The cane crushing systems, boilers and process house machines are mostly locally procured, where the powerhouse turbines and generators are imported from Peter Brotherhood. Sheikhoo Sugar Mills Limited has one of the most sophisticated imported computerized refineries for refining the sugar. This machinery is imported from Tate & Lyle United Kingdom.

➢ *Civil Work*

The civil work of the project comprise of the main factory building, Administration block, officers and labour residences, mosque, sugar godown, workshop, cane office and yard, store, gate office, boundary wall, overhead water tank, sewerage, drainage and external water supply system. The construction is of RCC type.

➢ *Technical Know How and Manpower*

The company has hired highly qualified and experienced persons to supervise the finance, cane, technical, and administration departments of the company. The accounting system including cane accounting is entirely computerized.

➢ *Project Operations*

The trial production was commenced on 13th November '94 and commercial production on 1st January '95. initially the mills' cane crushing capacity was 4,000 TCD which has been expanded to 12,000 tones TCD from 1997 to 2011. Currently Sheikhoo Sugar Mills Limited has the crushing capacity of 16000 TCD. The plant & machinery being imported/Local for this purpose is financed by internal generation of SSML.

The performance of Sheikhoo Sugar Mills Limited for the eighteen seasons have been summarized here under

YEAR	SEASON STARTED	SEASON CLOSED	CRUSHING CAPACITY	NO.OF WORKING DAYS	CANE CRUSHED (MT)	SUGAR PRODUCED (MT)	SALES (RS.IN BILLIONS)
1994-95			4,000	166	562,532	48,092	0.524
1995-96			6,000	146	607,394	49,450	1.030
1996-97			6,000	151	657,662	53,219	1.072
1997-98			6,000	159	758,297	62,137	0.944
1998-99			6,000	164	894,835	68,457	1.169
1999-00			6,000	128	647,146	54,345	0.987
2000-01			6,000	148	729,924	57,618	1.264
2001-02			6,000	148	897,832	76,238	1.322
2002-03			8,000	150	1,067,113	88,057	1.348
2003-04			10,000	152	1,223,323	104,356	1.293
2004-05			10,000	156	929,024	74,979	1.962
2005-06			10,000	130	586,133	43,852	1.404
2006-07			10,000	145	897,663	73,652	1.908
2007-08			12,000	150	1,275,365	106,738	2.457
2008-09			12,000	119	904,501	78,910	3.272
2009-10			12,000	119	849,252	75,378	4.465
2010-11			12,000	132	1,125,636	98,927	6.485
2011-12			14,000	146	1,405,792	128,477	5.992
2012-13			14,000	123	1,453,863	139,625	8.213
2013-14	25.11.2013	31.3.2014	14,000	127	1,571,695	153,560	7.743
2014-15	28.11.2014	31.3.2015	14,000	122	1,469,251	146,816	8.456
2015-16	30.11.2015	19.3.2016	16,000	119	1,465,280	146,336	8.890*

*Projected

➢ ***Major Achievements***

SSML has been third largest Sugar Cane Crushing Mills in Pakistan and is the largest amongst the mills having single tendom.

Sponsors' Professional Background

Mr. Anis Ahmed and his family have sponsored Sheikhoo Sugar Mills Limited. Mr. Anis Ahmed belongs to an old and well-reputed business family, which owned ***"Baksh Group of Companies"*** in the early 50's. The family first established a partnership company by the name of "UNITED COTTON AND WOOL TRADERS" which owned several cotton ginning factories in Sindh & Punjab. In 1959, the group established their shipping business by the name of UNITED ORIENTAL STEAMSHIP CO., which owned a largest fleet of ships in Pakistan. In addition to being well positioned in shipping, the family also established shipbuilding and repairing yard CARSTAIRS AND CUMMING, LTD., at the West Wharf in Karachi. They also provided training services to Merchant Naval Officers and Engineers who, within a short period of time, became recognized throughout the world for their expertise and professionalism. The Baksh Group also established large Jute Mills in 1960's in then East Pakistan namely United Jute, Magna Jute Mill and Chand Pur Jute Mill.

In 1970 they set-up a paint factory by the name of UNITED PAINTS (PAK) LTD. In early seventies, Mr. Anis Ahmed's father took over shipping side of the Baksh Group operation, however, after nationalization of shipping in 1974 he along with his family started business in U.K. and began their shipping business in the United Kingdom. Mr. Anis Ahmed and his brothers gained a rich & vast experience in all fields of shipping and finance.

With the introduction of liberal investment policy by the Government, Mr. Anis Ahmed and his family, set-up Sheikhoo Sugar Mills Ltd.

Feasibility Report

SHEIKHOO POWER (PVT) LIMITED

A FEASIBILITY FOR 30MW BAGASSE BASED POWER GENERATION PLANT

LOCATED AT PATTI NACH, SANAWAN, KOT ADDU

DISTRICT, MUZAFFER GARH

THE COMPANY

- Sheikhoo Sugar Mills Ltd. (SSML) is a public (unlisted)Limited company located at Pati Naich, Anwar Abad, Tehsil Kot Addu, District Muzaffar Garh. The SSML is engaged in the manufacturing and sale of sugar and its allied products.
- The Company is amongst the leading sugar mills in Pakistan in terms of sugar production as well as sucrose recovery. It is located in the best sugarcane growing belts between two rivers i.e Sindh and Chenab, in Pakistan, which has abundance of quality sugarcane with the high sucrose recovery rates in the Country which provides competitive advantage over other sugar mills.
- The Company owns and operates a 16,000 Tons Crushed per Day (TCD) sugar mill with 15MW powerhouse. The Company produces power through burning of bagasse, a waste product from sugarcane processing, to meet its captive requirements.
- The majority shareholders and directors are as follows:

S. No.	Name	Share holding %	Board of Directors
1	ANIS AHMED	29.33	DIRECTOR
2	IDREES AHMED	29.33	DIRECTOR
3	AZIZ AHMED	29.33	DIRECTOR

- The Sponsors and management have vast industry expertise and are credited with successfully developing, managing and profitably operating the plant.

Operational performance during last three years is provided in the table below:

Operational Performance	2015	2014	2013
Crushing Capacity (TCD)	16,000	16,000	14,000
Cane Crushed (Tons)	1,469,108	1,571,695	1,453,863
Sucrose Recovery (%)	10%	9.77%	9.6%
Capacity Utilization (%) (based on 120 days)	87.44%	93.55%	86.53%
Actual Sugar Production (Tons)	146,815	153,560	139,625

2. THE PROJECT

The Company proposes to put up a 30MW bagasse fired cogeneration under the Policy Framework for Power-Cogeneration 2013 for Bagasse / Bio Mass to include bagasse/ biomass under the ambit of the Renewable Energy Policy, 2006. Sugar mills have been involved in co-

generation for decades and are well versed with the process. The plant shall be based on the Bagasse as the sole fuel. Bagasse shall be fired into high pressure boilers to produce steam, which shall be used to generate 30MW electricity. The generation shall be used partly to meet the requirement of the sugar mill, while the spillover shall be sold to the Grid.

A new company, being the 100% subsidiary of Sheikhoo Sugar Mills Ltd., has been formed to put up the new Co-Generation plant. The name of the company is Sheikhoo Power (Pvt) Ltd. The company has three Directors to run the affairs of the company. These Directors are the nominee Directors of SSML having one share each. These three Directors are the elder sons of the three sponsoring Directors of SSML namely:

Mr. Yousaf Anis
Mr. Faisal Idrees
Mr. Osman Aziz Anwar

2.1INDUSTRY RE IEW

Affordable power is fundamental to economic stability and development. The worsening misalignment between energy demand and supply with major consequences on energy prices pose a major challenge for energy decision makers around the globe. More efficient use of energy sources can help to mitigate the impact of this negative trend.
Cogeneration based on bagasse represents an attractive and successful technology demonstrated in many sugarcane producing countries such as Mauritius, Reunion Island, India and Brazil. Combined heat and power in the form of power generation offers renewable energy options that promote sustainable development, take advantage of domestic resources, increase profitability and competitiveness in the industry, and cost-effectively address climate mitigation and other environmental goals. There is abundant opportunity for the wider use of bagasse-based cogeneration in sugarcane-producing countries like Brazil, India, Thailand, Pakistan, Mexico, Cuba, Colombia, Philippines and Vietnam as this potential remains largely unexploited. Current technologies, such as those in use in Mauritius, produce over 100 kWh of electricity per ton of bagasse. With a total world harvest of over 1.5 billion tons of sugar cane per year, the global energy potential from bagasse is over 150,000 GWH. Using Mauritius as a reference an annual potential of 6,000 GWH of additional electricity could be produced throughout Pakistan based on annual sugar cane production of 60 million tons. Actual electricity produced can even go higher than this estimate as recent cogeneration technology plants are being designed to produce from 300 to over 400 kWh of electricity per ton of bagasse.

2.2 CO-GENERATION IN PAKISTAN

In order for a sustainable future for Pakistan with regards to energy, it is necessary that the energy sector be accorded with high priority. Energy costs have to be reduced by focusing on reducing inefficiencies and shifting towards in-expensive fuel sources. Co-generation could play an important role in Pakistan's power sector in the future, especially bagasse based co-generation as Pakistan is amongst top 6 sugarcane producing countries with annual production of 60 million tons which creates an expected potential of 6,000 GWH of additional electricity throughout Pakistan. The development of bagasse based co-generation power projects also supports the objectives of the Government of Pakistan by:

(a) diminishing reliance on expensive fuel sources for thermal power generation;
(b) broadening the variety in Pakistan's electricity generation mix;
(c) facilitating in the declination of the excessive trade deficit.

2.3 POWER SECTOR STRUCTURE

The generation, transmission, distribution and retail supply of electricity in Pakistan is presently undertaken by two vertically integrated public sector utilities, with significant contribution to generation from various private IPPs. These utilities are Water and Power Development Authority **("WAPDA")** and Karachi Electric Supply Corporation **("KESC").** Being the largest electricity supplier of the country, WAPDA supplies power to all of Pakistan except the metropolitan city of Karachi and some of its surrounding areas which are supplied by KESC. WAPDA's distribution network has been divided into nine electric supply/distribution companies **("DISCOs")** structured in line with modern management practices. WAPDA's thermal power generation facilities have been restructured and incorporated to form four generation companies **("GENCOs").** In addition, a central power purchasing agency **("CPPA")**, National Transmission and Dispatch Company **("NTDC")** has been incorporated to perform transmission and dispatch functions.
IPPs sell directly to NTDC/CPPA for which tariff determination by NEPRA is a requirement. IPPs use the network of DISCOs for transmission and distribution. In case IPPs are not expected to sell directly to NTDC, such power plants do not fall under the umbrella of IPPs and tariff determination by NERPA is not a requirement and the transmission and distribution can still be through DISCOs network. The use of DISCOs network involves use of system **("UOSC")** Incase electricity generation facility is distant from the power purchaser facility, such that it involves the network of multiple DISCOS for transmission and distribution; this involves UOSC of multiple DISCOS and NTDC.

2.4 ELECTRICITY GENERATION

Total energy generation break-up in Pakistan is as follows:

Conventional thermal plants, those that use oil and natural gas, contribute of 62.4% of Pakistan's power generation capacity, followed by hydro-power generation, which is contributing up to 29.9% of Pakistan's power generation capacity. Increasing oil prices and accordingly increasing oil imports are already a significant burden on the national exchequer and the increasing import bill continues to exert further pressure on the foreign exchange reserves.
Depleting natural gas reserves is further aggravating the problem. Import of gas could be seen as a viable option to overcome the depleting domestic reserves, but gas import has significant issues, mainly the need for substantial capital investment in infrastructure, security difficulties and physical terrain concerns. Moreover, it would increase Pakistan's reliance on imported fuels with associated foreign exchange effects.

Alternatives to expensive and scarce electricity fuel sources are the use of coal based power, biomass based power, generation from hydro-electric or other renewable sources,

such as wind power. These options will assist in reducing Pakistan's reliance depleting natural gas and on imported oil, and consequent vulnerability to changes in global oil prices which will in turn have a positive impact on the current trade deficit and inflating import bill.

2.5 POWER CRISIS IN PAKISTAN

Pakistan's power sector is currently afflicted by a number of challenges that have led to a crisis:

A supply-demand gap, where the demand for electricity outstrips the current generation capacity leading to gap of up to 4,500 – 5,500 MW. The supply-demand gap has continuously grown over the past 5 years until reaching the existing levels. Such an enormous gap has led to load-shedding of 12-16 hours across the country. The Country has highly expensive electricity generation (approximately PKR 12 / unit) due to increased dependence on expensive thermal fuel sources including furnace oil and high speed diesel. The cost of generating power on furnace oil is PKR 17/ unit and on high speed diesel is PKR 23 / unit. Dependence on such expensive fuel sources has forced Pakistan to create electricity at rates that are not affordable.

Inefficient power transmission and distribution system that currently records losses of 23-25% due to poor infrastructure, mismanagement, and theft of electricity. The cost of delivering a unit of electricity to the end consumer has been estimated at PKR 14.70 by NEPRA. This means that the inefficiencies are costing the tax payers additional PKR 2.70 / unit over and above the cost of generation of PKR 12 / unit. Government has estimated the true cost of delivering a unit of electricity to the end consumer at greater than PKR 15.60 after taking into account the collection losses and the real losses to the distribution companies.

The aforementioned inefficiencies, theft, and high cost of generation are resulting in high levels of subsidies and circular debt.

2.6 DEMAND AND SUPPLY OF ELECTRICITY

The electricity demand and supply scenario below (WAPDA system only) reflects the gravity of problem that Pakistan is facing in the form of demand-supply gap:

Total installed electricity generation capacity in Pakistan is 23,578 MW whereas the available capacity remains less than 14,000 MW. Maximum electricity demand (peak demand) in the country stood at 24,593 MW which is forecasted to grow at around 5% to 6% over next ten years.

Expected available generation capacity by 2015 shows that an increase of more than 12,000 MW in installed capacity will be required to meet the demand of electricity in Pakistan. The Pakistan economy has beset with persistent power shortfalls over the past few years due to generation and other issues. The adverse balance of payments fueled by soaring fuel prices in the international market has further expanded the divide between generation costs and sale revenues. Hence, the Government has been working on a number of initiativesincluding:

- Increasing generation capacity
- Promoting generation from renewable resourcesto reduce import bill for generation fuels

2.7 PROJECT TARIFF

The tariff for the project was determined in May 2013 by NEPRA as an upfront tariff for new bagasse based co-generation power projects. The tariff incentivizes sugar millsto upgrade their existing generation capabilities from low pressure boilers to higher pressure boilers and reduce steam consumption for the Process House. Under the Project, the Company proposes to generate 2 times more electricity from the same fuel stock.

The project is expected to come online by Dec. 2018 and will benefit from the NEPRA's approved upfront 30 year tariff of USD cents 10.621/KwH (Levelized Tariff- PKR 10.41KwH). The salient features of the upfront tariff determined by NEPRA are as follows:

- Guaranteed tariff available to the Company.
- The Company has an option to approach NEPRA for tariff determination on the basis of Project specific dynamics etc, in case the upfront tariff is not acceptable to the Company. Presently the company has opted to go for the Up-front tariff.
- The Company has a choice to enter into Energy Purchase Agreement with either Central Power Purchasing Authority ("CPPA") or the relevant DISCO.
- Plant shall be on deemed dispatch basis and the Company shall be paid the tariff if it makes energy available
- Financial and fiscal incentives available to Power Producers under the Renewable Energy Policy, 2006 includes exemption of custom duty, sales tax etc on the import of machinery shall be available to the Company.

Item	Upfront Tariff	SSML
Tariff		
• First 10 years (PKR / kWh)	11.7396	Company is in process of applying upfront tariff for the Project
• Net 11 to 30 years (PKR / kWh)	7.9	
• Levelized Tariff (PKR / kWh)	10.41	
Project Cost Per MW (MILLION USD)	0.997	1.2839 Based on USD PKR parity of 112

3 PROJECT COST

The Project cost is estimated at PKR 4.313 Billion which is to be financed through debt equity ratio of 80:20. The Company has also undertaken PKR 350 Million of improvements in its process house which will result in higher steam efficiencies thereby saving bagasse for high pressure power generation and power sales.

Description	Main Facility	Total	Share %
Syndicated Loan	3,451	3,451	80%
Equity *	863	863	20%
Total	**4,314**	**4,314**	**100%**

*internal cash generation / own sources

The details of Project cost are provided in the table below:

S. #	Project Cost Detail	Amount US $ Millions	Amount Rs. Millions
1.	Civil Works	3.000	336
2.	Steam generator	8.000	896
3.	Turbine	4.500	504
4.	Bagasse handling, ash handling, cooling tower, pumps and steam, water pipping, walls and tanks.	3.540	397
5.	Water treatment, Crane, Air-conditioning system, Air compressor, fire protection system and distributed control system.	2.827	317
6.	Erection, installation, spare and labs equipment	1.653	185
7.	Power Transformers, Auxiliary and interconnection transformers, HT LT Package, cables and DG Set package	5.550	622
8.	Consultancy / detailed engineering	0.800	89
9.	Regulatory requirements /guarantees	0.110	12
10.	Transportation and miscellaneous	0.200	22
11.	Plant optimization	3.130	351
12.	Insurance Cost	0.263	29

13.	Contingences and duties	2.240	251
14.	Interest during construction	2.703	302
	Total Project Cost	**38.516**	**4313**

3.1 RATIONALE FOR BAGASSE-BASED COGENERATION/PROJECT

- High-pressure, bagasse based co-generation is a renewable and environment friendly energy source for augmenting generation capacity;
- Bagasse based generation offers import substitution of fuel, providing relief to the Country as it struggles to find a reasonable equilibrium in the balance of payments and signification generation cost savings;
- Near to zero supply fuel supply risk due to in-house bagasse availability from sugar mills;
- Promotion of renewable energy sources to replace fossil fuels;
- Sugarcane crushing season which runs between November and April coincides with non-gas and non-hydel months;
- Due to their rural (away from traditional load centers) and vastly spread locations, the sugar mills can be used to provide local distribution of power thereby reducing distribution costs;
- Diversification of revenues streams and monetization of bagasse for sugar mills.
- Support to the company in maintaining its profitability during downwards trend in the sugar prices.

3.2 PROJECT STATUS

- Company has appointed Avant – Garde Engineering & Consultants (FZC) as Project Technical Advisor ("TA") who will provide technical assistance to the Company. Avant - Garde is one of the world's leading integrated engineering services providing company.
- Order for bagasse fired high pressure boiler with a capacity of 150 TPH will be placed shortly.
- LOI approval letter has been received from Alternate Energy Development Board.
- A consultant for environment study has been appointed
- The Company plans to place orders for 30 MW Steam Turbo Generators (STGs) with Hangzhou Steam Turbine Co. Ltd., China ("**HTC**"). HTC is one of the world's leading steam turbine manufacturers. HTC employs Siemens designs in its turbines and introduced the designing and manufacturing technology of industrial steam turbines in China from Siemens, Germany in the 1970s.
- The consultant for grid interconnection study has been appointed.
- Project is expected to be completed before Dec. 2017 with a construction period of 18-22 months on a fast track basis. The Company has already completed work on the construction and installation of falling film evaporators along with other necessary equipment following recommendations by M/S IPRO, Germany, in their steam study of the mills; an important and the first step towards the start of the new co-generation project. The total cost of this phase of the project is estimated at Rs.350 million. The company had completed the installation of the evaporators before commencement of

season 2015-16. The installation of the falling film evaporators and other necessary equipment has enabled the company to improve its steam on cane ratio which has resulted in savings in the use of bagasse thereby making more bagasse available for the power generation in the off season.

4 FINANCIAL HIGHLIGHTS

A brief summary of the historical financial performance of SSML is shown below:

PKR in Million Income Statement Analysis	FY2014 Audited	FY2013 Audited	FY2012 Audited
Net Sales	7,743	8,213	5,992
Gross Profit	476	389	476
EBITDA	221	148	223
Net Income	151	164	182
Equity			
Long Term Debt	0	6	19
Current Liabilities	920	520	1,465
Short Term Debt	294	416	218
Total Liabilities	1,214	936	1,683
Total Assets	1,618	1,603	1,433
Current Assets	741	564	485
Stock in Trade	485	245	1,110
Current Ratio (x)	1.01: 0.99	1.0: 0.99	0.9: 1.05
Long term Debt to Equity (x)	0: 100	0.: 99.5	1.7: 98.3

A brief summary of the projected financial performance of SSML is shown below:

Financial Projections	Year 0 2014 Audited	Year I 2015	Year 2 2016	Year 3 2017	Year 4 2018	Year 5 2019	Year 6 2020	Year 7 2021	Year 8 2022
Tariff (PKR/kWh)					11.73	11.73	11.73	11.73	11.73
Net Sales	7,743	8,262	8,912	8,885	10,189	10,226	10,264	10,301	10,339
EBITDA	429	710	1,134	1,136	2,059	2,038	2,014	1,988	1,958
Finance Costs	104	123	103	83	381	329	278	226	175
Current Portion of LTD	6				575	575	575	575	575

Long Term Debt to Equity (x)	00:100	00:100	43:57	45:55	33:67	23:77	14:86	6:94	0:100

5. TRANSACTION HIGHLIGHTS

- Upfront tariff
- Off-taker credit risk; hedged due to In-house, local fuel supply for generation;
- Attractive generation cost / tariff both for producer and off taker; Push by the Government to expand renewable energy generation
- Existing in-house power expertise.
- Strong project cash flows with additional recourse to existing sugar cash flows / assets
- Increasingly de-levered balance sheet

6 TRANSACTION STRUCTURE

SSML is contemplating a Syndicated Term Finance Facility of PKR 3,451 Million. The Facility is envisaged to be extended for a period of eight (8) years inclusive of a grace period of two (2) years. Principal shall be repaid in 12 equal semi-annual installments commencing six months from the end of grace period. The Facility shall be secured against the first pari passu charge.

SHEIKHOO POWER (PVT.) LIMITED

A FEASIBILITY FOR 30MW BAGASSE BASED POWER GENERATION PLANT

LOCATED AT PATTI NACH, SANAWAN, KOT ADDU

DISTRICT, MUZAFFER GARH

[illegible]

[illegible]

[illegible]

SHEIKHOO POWER PVT. LTD.

PROJECTED BALANCE SHEET

	Sep., 30th	2019 Sep., 30th	2020 Sep., 30th	2021 Sep., 30th	2022 Sep., 30th	2023 Sep., 30th	2024 Sep., 30th	2025 Sep., 30th	2026 Sep., 30th
Fixed Assets - at cost less Acc. Dep.	3,907,900	3,647,248 0	3,406,211	3,183,149 0	2,976,572 0	2,785,121	2,607,560	2,442,764	2,289,706
Current Assets									
Stores & Spares		129,018	135,469	142,243	149,355	156,822	164,664	172,897	181,542
Trade Debts									
Advances, Deposits & Other Receivable									
Short Term Investment		0	0	0	0	0	0	0	0
Cash & Bank Balances	-	826,041	997,812	1,193,145	1,418,231	1,672,048	1,953,459	2,261,207	3,104,042 -
		955,059	1,133,281	1,335,387	1,567,586	1,828,870	2,118,122	2,434,104	3,285,584
Current Liabilities									
Short Term Borrowings									
Current Maturity of Long Term Loans		521,053	521,053	521,053 0	521,053 0	521,053	521,053		
	0	521,053	521,053	521,053	521,053	521,053	521,053	0	0
Net Working Capital	0	434,006	612,227	814,334	1,046,533	1,307,817	1,597,069	2,434,104	3,285,584
Total Assets	3,907,900	4,081,254	4,018,439	3,997,483	4,023,105	4,092,938	4,204,629	4,876,868	5,575,290
Represented By:									
Capital & Reserves									
Paid - up Capital	781,580	781,580	781,580	781,580	781,580	781,580	781,580	781,580	781,580
Public Issue		0	0	0	0				
Deposit for Shares		0	0	0	0				
Directors' Advances									
Unappropriated Profit / (Loss)		694,407	1,152,645	1,652,743	2,199,418	2,790,305	3,423,049	4,095,288	4,793,710
	781,580	1,475,987	1,934,225	2,434,323	2,980,998	3,571,885	4,204,629	4,876,868	5,575,290
Long Term Loans									
Long Term Finances	3,126,320	2,605,267	2,084,214	1,563,160	1,042,107	521,053	0		
Financial Leases				0	0				
	3,126,320	2,605,267	2,084,214	1,563,160	1,042,107	521,053	0	0	0
	3,907,900	4,081,254	4,018,439	3,997,483	4,023,105	4,092,938	4,204,629	4,876,868	5,575,290

SHEIKHOO SUGAR MILLS LTD.
PROJECTED CASH FLOW STATEMENT

	2019 Sep., 30th	2020 Sep., 30th	2021 Sep., 30th	2022 Sep., 30th	2023 Sep., 30th	2024 Sep., 30th	2025 Sep., 30th	2026 Sep., 30th
Sources								
Net Profit After Taxation	694,407	458,238	500,098	546,675	590,887	632,744	672,239	698,422
Add: Adjustments not Involving Cash								
Depreciation	260,652	241,037	223,062	206,577	191,451	177,561	164,796	153,058
Gain on disposal of operating fixed Assets								
Provision for Gratuity								
	260,652	241,037	223,062	206,577	191,451	177,561	164,796	153,058
Cash from Operations	955,059	699,275	723,160	753,252	782,338	810,305	837,035	851,480
Other Sources								
Long Term Loan								
Directors Advance			0	0				
Lease Deposit	0	0	0	0				
	0	0	0	0	0	0	0	0
Total Funds Generated During the Year	955,059	699,275	723,160	753,252	782,338	810,305	837,035	851,480
Applications								
Increase / (Decrease) in Current Assets								
Stores & Spares	129,018	6,451	6,773	7,112	7,468	7,841	8,233	8,645
Stock in Trade	0	0	0	0	0	0	0	0
Trade Debts	0	0	0	0	0	0	0	0
Advances, Deposits & Other Receivable	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
Advances, Deposits and Prepayments	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	129,018	6,451	6,773	7,112	7,468	7,841	8,233	8,645
(Increase) / Decrease in Current Liabilities								
Current Maturity of Long Term Loans	0		0	0	0			
Current Maturity of Leases	0	0	0	0	0	0	0	0
Short Term Borrowings	0	0	0	0	0	0	0	0
Trade Creditors	0	0	0	0	0	0	0	0
Workers' Welfare Fund	0	0	0	0	0	0	0	0
Workers' Profit Participation Fund	0	0	0	0	0	0	0	0
Provision for Taxation	0	0	0	0	0	0	0	0
Deferred Liabilities	0	0	0	0	0	0	0	0
Proposed Dividend								
	0	0	0	0	0	0	0	0
Total Funds Available	826,041	692,824	716,386	746,140	774,870	802,464	828,802	842,836
Other Payments								
Addition in Fixed Assets								
Long Term Loans		521,053	521,053	521,053	521,053	521,053	521,053	
Financial Leases								
Directors' Loan				0				
Dividend								
	0	521,053	521,053	521,053	521,053	521,053	521,053	0
Cash Surplus during the year	826,041	171,771	195,333	225,087	253,817	281,411	307,748	842,836
Opening Cash in Hand	0	826,041	997,812	1,193,145	1,418,231	1,672,048	1,953,459	2,261,207
Closing Cash in Hand	826,041	997,812	1,193,145	1,418,231	1,672,048	1,953,459	2,261,207	3,104,042

SHEIKHOO POWER PVT. LTD.

PROJECTED PROFIT AND LOSS ACCOUNT

		2019 Sep., 30th	2020 Sep., 30th	2021 Sep., 30th	2022 Sep., 30th	2023 Sep., 30th	2024 Sep., 30th	2025 Sep., 30th	2026 Sep., 30th
Sales		1,884,361	1,884,361	1,884,361	1,884,361	1,884,361	1,884,361	1,884,361	1,884,361
Cost of Sales		1,114,239	1,103,479	1,095,106	1,089,038	1,085,217	1,083,601	1,084,169	1,086,920
Gross Profit		770,123	780,882	789,255	795,324	799,145	800,760	800,192	797,442
Operating Expenses									
Administrative & Selling Expenses		24,250	26,675	29,343	32,277	35,504	39,055	42,960	47,256
Operating Profit / (Loss)		745,873	754,207	759,912	763,047	763,640	761,705	757,232	750,185
Other Income									
Non-operating Expenses									
Financial Charges			269,645	222,750	175,856	128,961	82,066	35,171	
Other Charges									
Worker's Profit Participation Fund		37,294	24,228	26,858	29,360	31,734	33,982	36,103	37,509
Worker's Welfare Fund		14,172	2,096	10,206	11,157	12,059	12,913	13,719	14,254
Total Non-operating Expenses		51,465	295,969	259,815	216,372	172,754	128,961	84,993	51,763
Net Profit / (Loss) Before Taxation	(3,907,900)	694,407	458,238	500,098	546,675	590,887	632,744	672,239	698,422
		0	0	0	0				
Income Tax									
Net Profit / (Loss) After Taxation		694,407	458,238	500,098	546,675	590,887	632,744	672,239	698,422
Un-appropriated Profit B/F		0	694,407	1,152,645	1,652,743	2,199,418	2,790,305	3,423,049	4,095,288
Profit Available for Appropriation		694,407	1,152,645	1,652,743	2,199,418	2,790,305	3,423,049	4,095,288	4,793,710
Dividend									
Net Profit / (Loss) C/F		694,407	1,152,645	1,652,743	2,199,418	2,790,305	3,423,049	4,095,288	4,793,710

SHEIKHOO POWER PVT. LTD.

SALES REVENUE	(Rs. '000)	(Rs. '000)	(Rs. '000)	(Rs. '000)	(Rs. '000)	(Rs. '000)	(Rs. '000)	(Rs. '000)
	2019	2020	2021	2022	2023	2024	2025	2026
	Sep., 30th	Sep., 30th	Sep., 30th	Sep., 30th	Sep., 30th	Sep., 30th	Sep., 30th	Sep., 30th
Sales								
Power sold to WAPDA during season	635,511	635,511	635,511	635,511	635,511	635,511	635,511	635,511
Power sold to WAPDA during off season	630,464	630,464	630,464	630,464	630,464	630,464	630,464	630,464
Total sales to WAPDA	1,265,975	1,265,975	1,265,975	1,265,975	1,265,975	1,265,975	1,265,975	1,265,975
Power sold to Sheikhoo Sugar	205,092	205,092	205,092	205,092	205,092	205,092	205,092	205,092
Steam sale to SSML	413,295	413,295	413,295	413,295	413,295	413,295	413,295	413,295
Total sales to SSML	618,386	618,386	618,386	618,386	618,386	618,386	618,386	618,386
Total sales	1,884,361	1,884,361	1,884,361	1,884,361	1,884,361	1,884,361	1,884,361	1,884,361
Cost of Sales								
- Raw Material Consumed	- 618,386	618,386	618,386	618,386	- 618,386	618,386	618,386	618,386 -
Power plant O & M	118,850	118,850	118,850	118,850	118,850	118,850	118,850	118,850
Salaries, Wages & Allowances	46,560	51,216	56,338	61,971	68,168	74,985	82,484	90,732
Repair & Maintenance	55,591	58,370	61,289	64,353	67,571	70,949	74,497	78,222
Postage, Telephone & Fax	500	550	605	666	732	805	886	974
Vehicle Running Expenses	3,000	3,300	3,630	3,993	4,392	4,832	5,315	5,846
Printing & Stationery	200	220	242	266	293	322	354	390
Traveling & Conveyance	5,000	5,500	6,050	6,655	7,321	8,053	8,858	9,744
Entertainment	500	550	605	666	732	805	886	974
Insurance	5,000	5,500	6,050	6,655	7,321	8,053	8,858	9,744
Depreciation	260,652	241,037	223,062	206,577	191,451	177,561	164,796	153,058
Total Manufacturing I	1,114,239	1,103,479	1,095,106	1,089,038	1,085,217	1,083,601	1,084,169	1,086,920
				0				
	1,114,239	1,103,479	1,095,106	1,089,038	1,085,217	1,083,601	1,084,169	1,086,920
	0	0	0	0	0	0	0	0
	1,114,239	1,103,479	1,095,106	1,089,038	1,085,217	1,083,601	1,084,169	1,086,920

SHEIKHOO POWER PVT. LTD.

ADMINISTRATIVE & SELLING EXPENSES	(Rs. '000)	(Rs. '000)	(Rs. '000)	(Rs. '000)	(Rs. '000)	(Rs. '000)	(Rs. '000)	(Rs. '000)
	2019 Sep., 30th	2020 Sep., 30th	2021 Sep., 30th	2022 Sep., 30th	2023 Sep., 30th	2024 Sep., 30th	2025 Sep., 30th	2026 Sep., 30th
Salaries, Allowances & Benefits	12,000	13,200	14,520	15,972	17,569	19,326	21,259	23,385
Rent, Rates & Taxes	5,000	5,500	6,050	6,655	7,321	8,053	8,858	9,744
Traveling & Conveyance	2,000	2,200	2,420	2,662	2,928	3,221	3,543	3,897
Entertainment	500	550	605	666	732	805	886	974
Printing & Stationery	1,000	1,100	1,210	1,331	1,464	1,611	1,772	1,949
Repair & Maintenance	500	550	605	666	732	805	886	974
Electricity, Water & Gases	2,000	2,200	2,420	2,662	2,928	3,221	3,543	3,897
Postage, Telephone & Fax	250	275	303	333	366	403	443	487
Vehicle Running	500	550	605	666	732	805	886	974
Fees & Subscription	500	550	605	666	732	805	886	974
Selling & Distribution								
	24,250	26,675	29,343	32,277	35,504	39,055	42,960	47,256
FINANCIAL CHARGES								
Mark up on Long Term Loans	0	269,645	222,750	175,856	128,961	82,066	35,171	0
Mark up on Short Term Loans	0							
Bank Charges & Others	0							
Mark up on Lease Financing	0							
	0	269,645	222,750	175,856	128,961	82,066	35,171	0

SHEIKHOO POWER PVT. LTD.
FINANCIAL RATIOS

		2019 Sep., 30th	2020 Sep., 30th	2021 Sep., 30th	2022 Sep., 30th	2023 Sep., 30th	2024 Sep., 30th	2025 Sep., 30th	2026 Sep., 30th
Profitability									
Gross Profit to Sales		41%	41%	42%	42%	42%	42%	42%	42%
Operating Profit to Sales		40%	40%	40%	40%	41%	40%	40%	40%
Net Profit to Sales		37%	24%	27%	29%	31%	34%	36%	37%
Operational									
Current Ratio		1.83 : 1	2.17 : 1	2.56 : 1	3.01 : 1	3.51 : 1	4.07 : 1	#DIV/0!	#DIV/0!
Liquidity Ratio		1.59 : 1	1.91 : 1	2.29 : 1	2.72 : 1	3.21 : 1	3.75 : 1	#DIV/0!	#DIV/0!
Debt Equity Ratio	80 : 20	64 : 36	52 : 48	39 : 61	26 : 74	13 : 87	0 : 100	0 : 100	0 :-100
Earnings									
EBITDA		955,059	968,920	945,910	929,108	911,298	892,371	872,206	851,480
Return on Total Capital Employed		15%	10%	10%	11%	11%	11%	9%	8%
Return on Shareholder's Equity		89%	59%	64%	70%	76%	81%	86%	89%
Earning Per Share (Rs. 10/-)		Rs. 8.88	Rs. 5.86	Rs. 6.40	Rs. 6.99	Rs. 7.56	Rs. 8.10	Rs. 8.60	Rs. 8.94
Repayments									
Financial Charge Coverage			3.59 Time	4.25 Time	5.28 Time	7.07 Time	10.87 Time	24.80 Time	
Debt Coverage		2.83 Time	1.88 Time	1.97 Time	2.08 Time	2.20 Time	2.34 Time	24.80 Time	

SHEIKHOO POWER PVT. LTD.

REVENUE ASSUMPTIONS

		2019 Sep., 30th	2020 Sep., 30th	2021 Sep., 30th	2022 Sep., 30th	2023 Sep., 30th	2024 Sep., 30th	2025 Sep., 30th
Plant Capacity per day 30 MW units Per/Hour		30,000	30,000	30,000	30,000	30,000	30,000	30,000
Power available during season		26,951	26,951	26,951	26,951	26,951	26,951	26,951
Crushing Days		120	120	120	120	120	120	120
Total Power available		77,618,880	77,618,880	77,618,880	77,618,880	77,618,880	77,618,880	77,618,880
Power sold to Sheikhoo Sugar (units)		17,470,080	17,470,080	17,470,080	17,470,080	17,470,080	17,470,080	17,470,080
Capacity utilisation for sale to WAPDA		90%	90%	90%	90%	90%	90%	90%
Power sold to WAPDA during season (u	107,838,000	54,133,920	54,133,920	54,133,920	54,133,920	54,133,920	54,133,920	54,133,920
Power rate		11.7396	11.7396	11.7396	11.7396	11.7396	11.7396	11.7396
Power sold to WAPDA during season (F	1,265,974,985	635,510,567	635,510,567	635,510,567	635,510,567	635,510,567	635,510,567	635,510,567
Sale to Sheikhoo Sugar (Rs)		205,091,751	205,091,751	205,091,751	205,091,751	205,091,751	205,091,751	205,091,751
Power sold to WAPDA in off season (no. of days)		94	94	94	94	94	94	94
Power sold to WAPDA during off season (units)		53,704,080	53,704,080	53,704,080	53,704,080	53,704,080	53,704,080	53,704,080
Power sold to WAPDA during off season (RS)		630,464,418	630,464,418	630,464,418	630,464,418	630,464,418	630,464,418	630,464,418
Bagasse Purchased (Tons)		247,355	247,355	247,355	247,355	247,355	247,355	247,355
Bagasse Purchased Rate (Tons)		2,500	2,500	2,500	2,500	2,500	2,500	2,500
Bagasse Purchased Rs.		618,386,400	618,386,400	618,386,400	618,386,400	618,386,400	618,386,400	618,386,400
O & M (PKR/KWH) 0.85	139,823,280	118,849,788	118,849,788	118,849,788	118,849,788	118,849,788	118,849,788	118,849,788

		Electricity Produced	Auxilary Consumption	Sold To SSML	Total Available			TOTAL POWER SOLD @90%
Annual Bagasse Generation	486,000.00							
Bagasse Consumption HP - season	152,575.85	29,617.00	(2,666)	(6,066)	20,885	For WAPDA	60,148,800	54,133,920
Bagasse Consumption LP - season	238,645.44	7,579.00	(1,305)	6,066	12,340	For SSML	35,539,200	31,985,280
	391,221.29	37,196	(3,971)	0	33,225		95,688,000	
Bagasse Saved for off season	94,778.71	30,000.00	(3,550)		26,450	For WAPDA	59,671,200	53,704,080
							155,359,200	139,823,280

Sheikhoo Sugar Mills Ltd. Loan Repayment Schedule		Rs in Millions																
LOAN		3,126,320																
MARK UP		9%																
INSTALMENTS		12																
GRACE PERIOD	MONTHS	24																
		6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	
OPENING BALANCE	3,126,320	3,126,320	3,126,320	3,126,320	3,126,320	3,126,320	2,865,794	2,605,267	2,344,740	2,084,214	1,823,687	1,563,160	1,302,633	1,042,107	781,580	521,053	260,527	
MARK UP		70,342	70,342	70,342	70,342	140,684	128,961	117,237	105,513	93,790	82,066	70,342	58,619	46,895	35,171	23,447	11,724	
INSTALMENTS						260,527	260,527	260,527	260,527	260,527	260,527	260,527	260,527	260,527	260,527	260,527	260,527	
CLOSING BALANCE						2,865,794	2,605,267	2,344,740	2,084,214	1,823,687	1,563,160	1,302,633	1,042,107	781,580	521,053	260,527	(0)	

TECHNO COMMERCIAL REPORT

(30 MW Co-Generation Power Project)

SHEIKHOO POWER (PVT) LIMITED
MUZAFARGARH DISTRICT, PAKISTAN

Sheikhoo Sugar Mills Limited - Bagasse based Cogeneration Study of 110 bar and 67 bar systems with and without High Pressure Feed water heaters

Subsequent to the submission of the concept report, in the meeting on the 5th Oct 2015, SSML said that they would like to go with a high pressure Cogeneration plant with a 150 TPH boiler and a TG with about 30 MW nominal capacity. This proposed high pressure Cogeneration plant will operate in synchronization with the existing low pressure boilers and TGs. SSML will later decide about replacing the complete low pressure systems with a high pressure system. SSML wanted Avant-Garde to study the following alternatives.

1. A 150 TPH boiler and a matching extraction condensing turbogenerator with the boiler outlet steam parameters of 110 bar(a) and 540 Deg.C and with the boiler feed water temperature of 210 deg.C, operating in synchronization with the required number of LP boilers, drive turbines and turbogenerators.

2. A 150 TPH boiler and a matching extraction condensing turbogenerator with the boiler outlet steam parameters of 110 bar(a) and 540 Deg.C and with the boiler feed water temperature of 105 deg.C, operating in synchronization with the required number of LP boilers, drive turbines and turbogenerators.

3. A 150 TPH boiler and a matching extraction condensing turbogenerator with the boiler outlet steam parameters of 67 bar(a) and 485 Deg.C and with the boiler feed water temperature of 170 deg.C, operating in synchronization with the required number of LP boilers, drive turbines and turbogenerators.

4. A 150 TPH boiler and a matching extraction condensing turbogenerator with the boiler outlet steam parameters of 67 bar(a) and 485 Deg.C and with the boiler feed water temperature of 105 deg.C, operating in synchronization with the required number of LP boilers, drive turbines and turbogenerators.

SSML said that the mills 1, 3, 4 and 5 and the fibrizer will continue to be driven by steam turbines drawing steam from the low pressure boilers. SSML also said that the total electrical power consumption of the sugar mill under the present operating condition is 14,500 kW. This includes the power consumption of the existing four (4) boilers. It is assumed that excluding the power consumption of the existing boilers, the power consumption of the sugar mill is 12,340 kW.

Alternative I:

Under this alternative, the Turbogenerator will be of 30 MW nominal capacity and the maximum possible process steam supply from the HP Cogeneration plant will be 100 TPH @ 2.5 bar. The balance process steam requirement of 180.14 TPH at 2.5 bar and the requirement of 4 TPH at 4 bar will be met from the LP system. Three out of four LP boilers will be in operation generating an aggregate steam quantity of 184.14 TPH. After meeting the steam requirements of the drive turbines of the mills and the fibrizer about 80.34 TPH of LP steam will be available for running the existing TGs. The expected aggregate power generation from the TGs 1,2 & 3 is 7579 kW. The power consumption of the three operating boilers is estimated to be 1305 kW. The power generation in the HP Cogeneration plant is estimated to be 29617 kW during the season. The exportable power under this alternative, during the season operation, will be 20885 kW.

In the off-season operation, the gross power generation in the HP system will be 30,000 kW and the boiler will be generating 117.8 TPH of steam. The export from the plant during the off-season will be 26450 kW, after providing for the auxiliary power and the consumption of 1000 kW in the sugar mill.

With the season days of 120, the saving in the bagasse for the off-season operation of the Cogeneration plant will be 94778.71 MT and this will meet the fuel requirement for 94 days of the HP Cogeneration system operation in the off-season.

The annual export from the plant will be 107.84 Million Units.

Attached New Fig. I.1 and I.2 give the proposed Cogeneration schemes respectively for the season and off-season operation for the Alternative I.

Alternative II:

Under this alternative, the Turbogenerator will be of 32 MW nominal capacity and the maximum possible process steam supply from the HP Cogeneration plant will be 125 TPH @ 2.5 bar. The balance process steam requirement of 155.14 TPH at 2.5 bar and the requirement of 4 TPH at 4 bar will be met from the LP system. Two out of four LP boilers will be in operation generating an aggregate steam quantity of 159.14 TPH. After meeting the steam requirements of the drive turbines of the mills and the fibrizer about 55.34 TPH of LP steam will be available for running the existing TGs. The expected aggregate power generation from the TGs 1,2 & 3 is 5221 kW. The power consumption of the two operating boilers is estimated to be 1080 kW. The power generation in the HP Cogeneration plant is estimated to be

31212 kW during the season. The exportable power under this alternative, during the season operation, will be 20173 kW.

In the off-season operation, the gross power generation in the HP system will be 32,000 kW and the boiler will be generating 116 TPH of steam. The export from the plant during the off-season will be 28248 kW, after providing for the auxiliary power and the consumption of 1000 kW in the sugar mill.

With the season days of 120, the saving in the bagasse for the off-season operation of the Cogeneration plant will be 100618.11 MT and this will meet the fuel requirement for 87 days of the HP Cogeneration system operation in the off-season.

The annual export from the plant will be 105.37 Million Units.

Attached New Fig. II.1 and II.2 give the proposed Cogeneration schemes respectively for the season and off-season operation for the Alternative II.

Alternative III:

Under this alternative, the Turbogenerator will be of 27 MW nominal capacity and the maximum possible process steam supply from the HP Cogeneration plant will be 110 TPH @ 2.5 bar. The balance process steam requirement of 170.14 TPH at 2.5 bar and the requirement of 4 TPH at 4 bar will be met from the LP system. Three out of four LP boilers will be in operation generating an aggregate steam quantity of 174.14 TPH. After meeting the steam requirements of the drive turbines of the mills and the fibrizer about 70.34 TPH of LP steam will be available for running the existing TGs. The expected aggregate power generation from the TGs 1,2 & 3 is

6636 kW. The power consumption of the three operating boilers is estimated to be 1305 kW. The power generation in the HP Cogeneration plant is estimated to be 26482 kW during the season. The exportable power under this alternative, during the season operation, will be 17222 kW.

In the off-season operation, the gross power generation in the HP system will be 27,000 kW and the boiler will be generating 113.6 TPH of steam. The export from the plant during the off-season will be 23840 kW, after providing for the auxiliary power and the consumption of 1000 kW in the sugar mill.

With the season days of 120, the saving in the bagasse for the off-season operation of the Cogeneration plant will be 102281.05 MT and this will meet the fuel requirement for 102 days of the HP Cogeneration system operation in the off-season.

The annual export from the plant will be 97.16 Million Units.

Attached New Fig. III.1 and III.2 give the proposed Cogeneration schemes respectively for the season and off-season operation for the Alternative III.

Alternative IV:

Under this alternative, the Turbogenerator will be of 28 MW nominal capacity and the maximum possible process steam supply from the HP Cogeneration plant will be 125 TPH @ 2.5 bar. The balance process steam requirement of 155.14 TPH at 2.5 bar and the requirement of 4 TPH at 4 bar will be met from the LP system. Two out of four LP boilers will be in operation generating an aggregate steam quantity of 159.14 TPH. After meeting the steam requirements of the drive turbines of the mills and the fibrizer about 55.34 TPH of LP steam will be available for running the

existing TGs. The expected aggregate power generation from the TGs 1,2 & 3 is 5221 kW. The power consumption of the two operating boilers is estimated to be 1080 kW. The power generation in the HP Cogeneration plant is estimated to be 27140 kW during the season. The exportable power under this alternative, during the season operation, will be 16607 kW.

In the off-season operation, the gross power generation in the HP system will be 28,000 kW and the boiler will be generating 110.6 TPH of steam. The export from the plant during the off-season will be 24732 kW, after providing for the auxiliary power and the consumption of 1000 kW in the sugar mill.

With the season days of 120, the saving in the bagasse for the off-season operation of the Cogeneration plant will be 105503.16 MT and this will meet the fuel requirement for 99 days of the HP Cogeneration system operation in the off-season.

The annual export from the plant will be 95.93 Million Units.

Attached New Fig. IV.1 and IV.2 give the proposed Cogeneration schemes respectively for the season and off-season operation for the Alternative IV.

The attached Table I gives the details pertaining to the operation of the above four Alternatives. This Table also provides the Heat rate, Efficiency and the specific Fuel consumption for the high pressure Cogeneration plant for each of the alternatives.

The estimated EPC cost for the four Alternatives respectively could be US$36, US$ 39, US$ 31.5 and US$ 33 Million. These costs are for the systems without any coal firing provisions.

SHEIKHOO SUGAR MILLS LIMITED

CONCEPT PAPER ON BAGASSE BASED COGENERATION PROJECT - CRUSHING CAPACITY 16000 TCD

STUDY OF 110 BAR & 67 BAR SYSTEMS WITH AND WITH OUT HIGH PRESSURE FEED WATER HEATING

TABLE - I

S.NO	DESCRIPTION	Alt_I 110 BAR WITH HP HTRS	Alt_II 110 BAR W.O HP HTRS	ALT_III 67 BAR WITH HP HTR	ALT_IV 67 BAR W.O HP HTR
I	Sugar Plant Operating Data				
1	Crushing Capacity (TCH)	667.00	667.00	667.00	667.00
2	Bagasse Generated (TPH @ 29.55% an Cane)	197.10	197.10	197.10	197.10
3	Bagasse for Bagacillo & Losses (TPH)	9.60	9.60	9.60	9.60
4	Bagasse available for usage in Cogeneration (TPH)	187.50	187.50	187.50	187.50
5	2.5 bar (a) steam requirement @ 42% (TPH)	280.14	280.14	280.14	280.14
6	Recoverable candensate fram 2.5 bar(a) steam to process (TPH)	271.74	271.74	271.74	271.74
7	4 bar (a) steam required for sugar Pracess (TPH)	4.00	4.00	4.00	4.00
8	Condensate Return fram 4 Bar Steam supply (TPH)	0.00	0.00	1.00	1.00
9	Electrical Power requirement af the sugar mill (kw) (With all the bailers in Operatian)	14500.00	14500.00	14500.00	14500.00
10	Average Number of Days of Season Operation	120	120	120	120
11	Annual Bagasse Generation considering 90% plant Capacity Utilization for Sugar Mill (MT)	486000.00	486000.00	486000.00	486000.00

S.NO	DESCRIPTION	Alt_I 110 BAR WITH HP HTRS	Alt_II 110 BAR W.O HP HTRS	ALT_III 67 BAR WITH HP HTR	ALT_IV 67 BAR W.O HP HTR
II	Season Operation				
II.1	High Pressure Cogeneration System				
1	Boiler Outlet Steam Pressure (bar(a))	110.00	110.00	67.00	67.00
2	Boiler Outlet Steam Temperature (Deg.C)	540.00	540.00	485.00	485.00
3	Boiler Feed Water inlet Temperature (Deg.C)	210.00	105.00	170.00	105.00
4	No. of Boilers	1	1	1	1
5	Total Boiler Steam Generation capacity (TPH)	150.00	150.00	150.00	150.00
6	Individual Boiler Capacities (TPH/TPH)	150	150	150	150
7	Actual HP Steam Generation in Seaosn (TPH)	150.00	150.00	150.00	150.00
8	Bogasse consumption (TPH)	58.86	69.11	60.97	67.23
9	Extraction Condensing TG Capacity (MW)	30.00	32.00	27.00	28.00
10	Number of Extraction Condensing TGs	1	1	1	1
11	Bockpressure TG Capacity (MW)	NA	NA	NA	NA
12	Number of Backpressure TGs	NA	NA	NA	NA
13	Generation in Extraction Condensing TGs in Season (kW)	29617	31212	26482	27140
14	Generation in Backpressure TG in Season (kW)	NA	NA	NA	NA
15	Total Gross Power Generation in the HP System in Season (kW)	29617	31212	26482	27140

S.NO	DESCRIPTION	Alt_I 110 BAR WITH HP HTRS	Alt_II 110 BAR W.O HP HTRS	ALT_III 67 BAR WITH HP HTR	ALT_IV 67 BAR W.O HP HTR
16	2.5 bar(a) Process steam supply from HP Cogen Plant (TPH)	100.00	125.00	110.00	125.00
17	4 bar(a) steam supply to process from HP System (TPH)	0.00	0.00	0.00	0.00
18	HP Cogen Auxiliary Power Consumption (kW)	2666.00	2840.00	2251.00	2334.00
II.2	**Existing Low Pressure System**				
1	Boiler Outlet Steam Pressure (Bar)	24.00	24.00	24.00	24.00
2	Boiler Outlet Steam Temperature (Deg.C)	350.00	350.00	350.00	350.00
3	Boiler Feed Water temperature (Deg.C)	105.00	105.00	105.00	105.00
4	2.5 bar Process Steam Required from LP System (TPH)	180.14	155.14	170.14	155.14
5	4 bar Process Steam Required fram LP System (TPH) (Note 1)	4.00	4.00	4.00	4.00
6	Total Process Steom required from the LP Boilers (TPH)	184.14	159.14	174.14	159.14
7	Copacity af each of the existing bailers (TPH)	80.00	80.00	80.00	80.00
8	Total number of Boilers available	4.00	4.00	4.00	4.00
9	Total Steam Generatian Required from LP System (TPH) (Nate 2)	184.14	159.14	174.14	159.14
10	Number of boilers required to be in Operatian for meeting the required pracess steam	3.00	2.00	3.00	2.00
11	Steam Generation in Each of the LP Boiler (TPH)	61.38	79.57	58.05	79.57
12	Bagasse Consumption in Each of the LP Boiler (TPH)	30.69	39.79	29.02	39.79

S.NO	DESCRIPTION	Alt_I 110 BAR WITH HP HTRS	Alt_II 110 BAR W.O HP HTRS	ALT_III 67 BAR WITH HP HTR	ALT_IV 67 BAR W.O HP HTR
13	Total Bagasse Consumption in the LP Boilers (TPH)	92.07	79.57	87.07	79.57
14	Steam Required for running the drives of Mills 1,3,4 & 5 (TPH) (Nate 3)	41.40	41.40	41.40	41.40
15	Steam required for running the Fibrizer Turbine (TPH)	62.40	62.40	62.40	62.40
16	Balance LP Steam available for running the LP TGs (TPH)	80.34	55.34	70.34	55.34
17	Maximum Steam Consumption in TGs 1,2 & 3 ot MCR (TPH) (Note 3)	93.1	93.1	93.1	93.1
18	Actual steam available for Power generation in TGs 1,2 & 3 (TPH)	80.34	55.34	70.34	55.34
19	Expected Power Generation in TGs 1,2 & 3 (kW) (Note 4) with an MCR specific steam consumption af 10.6 kg/kW	7579	5221	6636	5221
20	Total Power Generatian in LP TGs (kW)	7579	5221	6636	5221
21	Estimated Power consumption of the LP Boiler system (kW)	1305	1080	1305	1080
III	**Power Generation, Auxiliary Consumption & Export In Season**				
1	Generation in the HP system (kW)	29617.00	31212.00	26482.00	27140.00
2	Generation in the LP System (kW)	7579.00	5221.00	6636.00	5221.00
3	Total Power Generation in the Mill complex (kW)	37196.00	36433.00	33118.00	32361.00
4	Auxiliary power Consumption of the HP System (kW)	2666.00	2840.00	2251.00	2334.00
5	Auxiliary Power Consumption of the LP System (kW) (Note 5)	1305.00	1080.00	1305.00	1080.00
6	Power Consumption of the Sugar Mill less the Boilers (kW) (The power consumption of the four boilers are deducted)	12340.00	12340.00	12340.00	12340.00

S.NO	DESCRIPTION	Alt_I 110 BAR WITH HP HTRS	Alt_II 110 BAR W.O HP HTRS	ALT_III 67 BAR WITH HP HTR	ALT_IV 67 BAR W.O HP HTR
7	Export fram the Mill (kW)	20885.00	20173.00	17222.00	16607.00
IV	**Bagasse Balances**				
1	Bagasse from Crushing Operations (MT)	486000.00	486000.00	486000.00	486000.00
2	Bgasse Consumption in the HP system (MT)	152575.85	179136.45	158033.51	174251.40
3	Bagasse Consumption in the LP System (MT)	238645.44	206245.44	225685.44	206245.44
4	Total Bagasse Consumption in Season (MT)	391221.29	385381.89	383718.95	380496.84
5	Saving in bagasse For Off-Season Operation (TPH)	94778.71	100618.11	102281.05	105503.16
V	**Off-Season Operation (Operation of the HP System with saved bagasse)**				
1	Number of Boilers in Operation	1	1	1	1
2	Number of TGs in Operation	1	1	1	1
3	Total Steam generation (TPH)	117.80	116.00	113.60	110.60
4	Bagasse consumption (TPH)	46.68	53.44	46.54	49.54
5	Number of days of operation with saved bagasse	94.00	87.00	102.00	99.00
6	Coal consumption (HHV of 5625 kCals/kg) (TPH)	0.00	0.00	0.00	0.00
7	Off-Season operation days with coal (Considering a total of 330 days per annum)	0.00	0.00	0.00	0.00
8	Coal requirement for off-seasan operation (MT/Annum)	0.00	0.00	0.00	0.00
9	Gross power generation (kW)	30000.00	32000.00	27000.00	28000.00

S.NO	DESCRIPTION	Alt_I 110 BAR WITH HP HTRS	Alt_II 110 BAR W.O HP HTRS	ALT_III 67 BAR WITH HP HTR	ALT_IV 67 BAR W.O HP HTR
10	Power consumption in sugar plant (kW)	1000.00	1000.00	1000.00	1000.00
11	Auxiliary power consumption (kW)	2550.00	2752.00	2160.00	2268.00
12	Exportable Power in Off-season (kW)	26450.00	28248.00	23840.00	24732.00
VII	**Annual Export**				
1	Season Electrical Energy Export (Million Units) Considering 90% plant Capocity Utilization factor	54.13	52.29	44.64	43.05
2	Off_season Electrical Energy Export (With 90% CUF) (million Units)				
	With Bagasse as the Fuel (Million Units)	53.70	53.08	52.52	52.89
	With Coal (Million Units)	0.00	0.00	0.00	0.00
3	Total Annual Electrical Energy Export (Million Units)	107.84	105.37	97.16	95.93
4	Total Export Only from in-house Bagasse (Million Units)	107.84	105.37	97.16	95.93
VIII	**Efficiency, Heat Rate & Specific Fuel Consumption of the HP Cogen plant**				
	Bagasse Gross Calorific Value (kJ/kg) (Note 6)	9312.00	9312.00	9312.00	9312.00
	NCV of Bagasse (kJ/kg)	7456.23	7456.23	7456.23	7456.23
	Boiler Efficiency on GCV (%)	70.00	70.00	70.00	70.00
	Boiler Outlet Steam Enthalpy (kJ/kg)	3459.00	3459.00	3372.00	3372.00
	Boiler Feed Wataer Enthalpy in Season (kJ/kg)	901.00	455.70	722.50	450.60
	Bailer Duty in Season (MMkJ/hr)	383.70	450.50	397.43	438.21

S.NO	DESCRIPTION	Alt_I 110 BAR WITH HP HTRS	Alt_II 110 BAR W.O HP HTRS	ALT_III 67 BAR WITH HP HTR	ALT_IV 67 BAR W.O HP HTR
	Fuel Consumption in Season (TPH)	58.86	69.11	60.97	67.23
	Net Heat Input to the Plant (MMkJ/hr)	438.90	515.31	454.60	501.26
	Net Power Output in Season (kW)	26951.00	28372.00	24231.00	24806.00
	Net Heat Rate in Season (based on NCV) (kJ/kwhr)	16285.28	18162.61	18761.27	20207.09
	Net Plant Efficiency based on NCV in Season (%) (Note 7)	22.11	19.82	19.19	17.82
	Boiler Feed water Enthalpy in Off-Season (kJ/kg)	876.20	455.80	701.30	452.40
	Boiler Duty in Off-Season (MMkJ/hr)	304.25	348.37	303.39	322.91
	Fuel Consumption in Off-Season (TPH)	46.68	53.44	46.54	49.54
	Net Heat Input to the Plant in Off-Season (MMkJ/hr)	348.03	398.49	347.04	369.37
	Net Power Output in Off-Season (kW)	27450.00	29248.00	24840.00	25732.00
	Net Heat Rate in off-season (based on NCV) (kJ/kwhr)	12678.62	13624.62	13971.09	14354.34
	Net Plant Efficiency based on NCV in off-season (%)	28.39	26.42	25.77	25.08
	Average Efficiency (%)	25.25	23.12	22.48	21.45
	Specific Fuel Consumption:				
	Season (kg of bagasse per kW of net power output) (kg/kWhr)	2.18	2.44	2.52	2.71
	Off-Season (kg of bagasse per kW of net power output) (kg/kWhr)	1.70	1.83	1.87	1.93
	Average Specific Fuel Consumption (kg/kWhr)	1.94	2.13	2.19	2.32

S.NO	DESCRIPTION	Alt_I 110 BAR WITH HP HTRS	Alt_II 110 BAR W.O HP HTRS	ALT_III 67 BAR WITH HP HTR	ALT_IV 67 BAR W.O HP HTR

Note

1 The entire 4 bar steam will be drawn from the existing LP system.

2 It is assumed that the additional steam quantity made available consequent to the spray in the process streams for its conditioning will meet with the deaerator steam requirements of the LP Boilers. It is assume that the average exhuast steam from the drive turbines and the TGs will be at around 180 Deg.C.

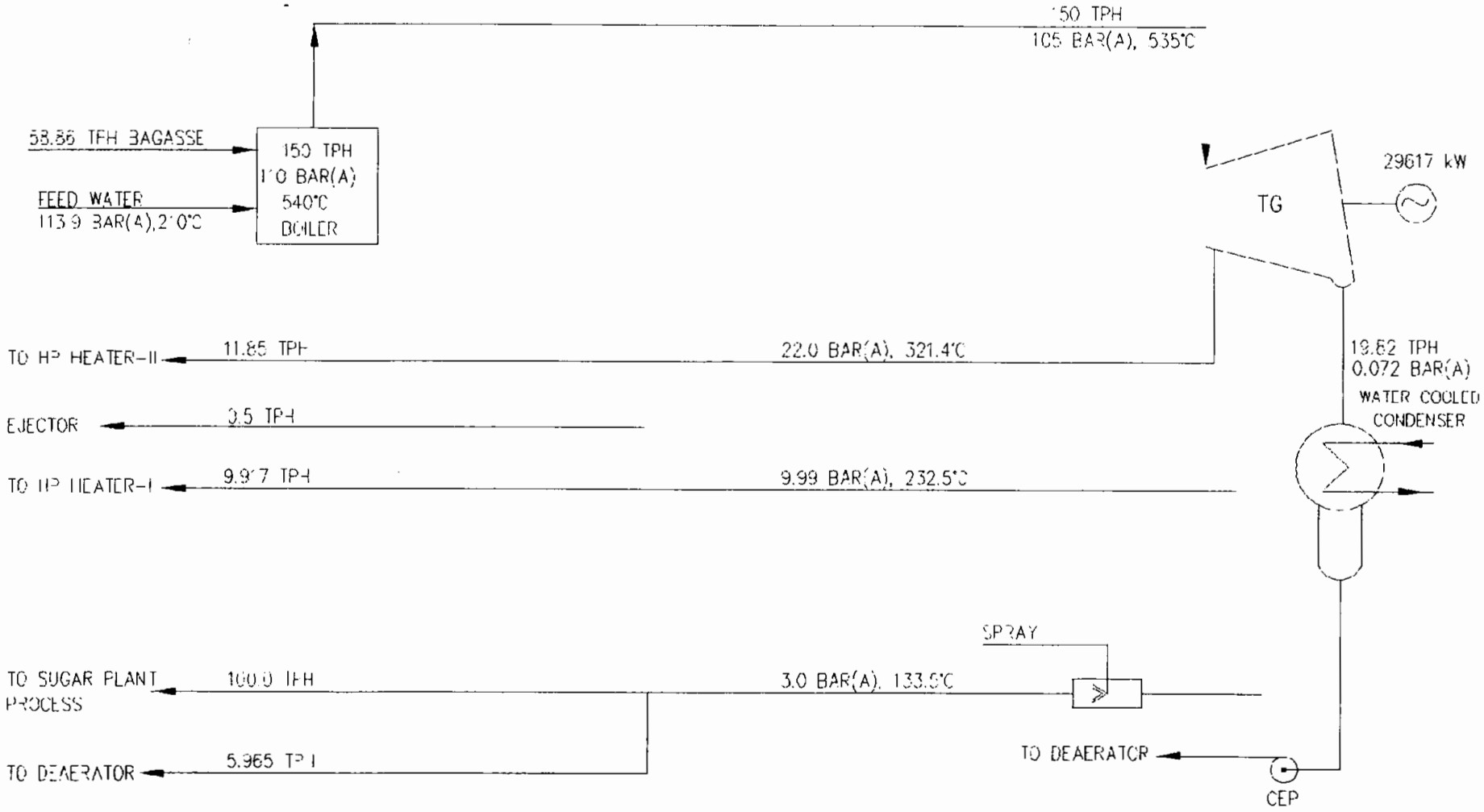
3 The steam consumption figures are taken from the current operating data provided.

4 It is assumed that the specific steam consumption in the 3 MW TGs is 10.6 kg/kwhr even under part load. Realistically the value should come down. As the part load characteristics of the 3 MW TGs are available this assumption is made.

5 Only the Boiler power consumption is taken into account. Other consumptions for TGs and other auxiliary ssytems are ignored.

6 The bagasse calorific value tested in a few plants in Pakistan is 2224 kCals/kg

7 This projection is only for the electric efficiency. The calculation igonres the energy supplied to the sugar mill in the form of process steam during the season aperation.



ENGINEERING CONTRACTOR: AVANT-GARDE ENGINEERS AND CONSULTANTS (P) LTD. CHENNAI 600 116, INDIA.	CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,		
	PROJECT	BAGASSE BASED COGENERATION PROJECT		
	PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE		
	TITLE	COGENERATION SCHEME – SEASON OPERATION	DRAWING NO. NEW FIG.I.1	REV. 0

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APPD	S.BALASUBRAMANIAN		16.10.15

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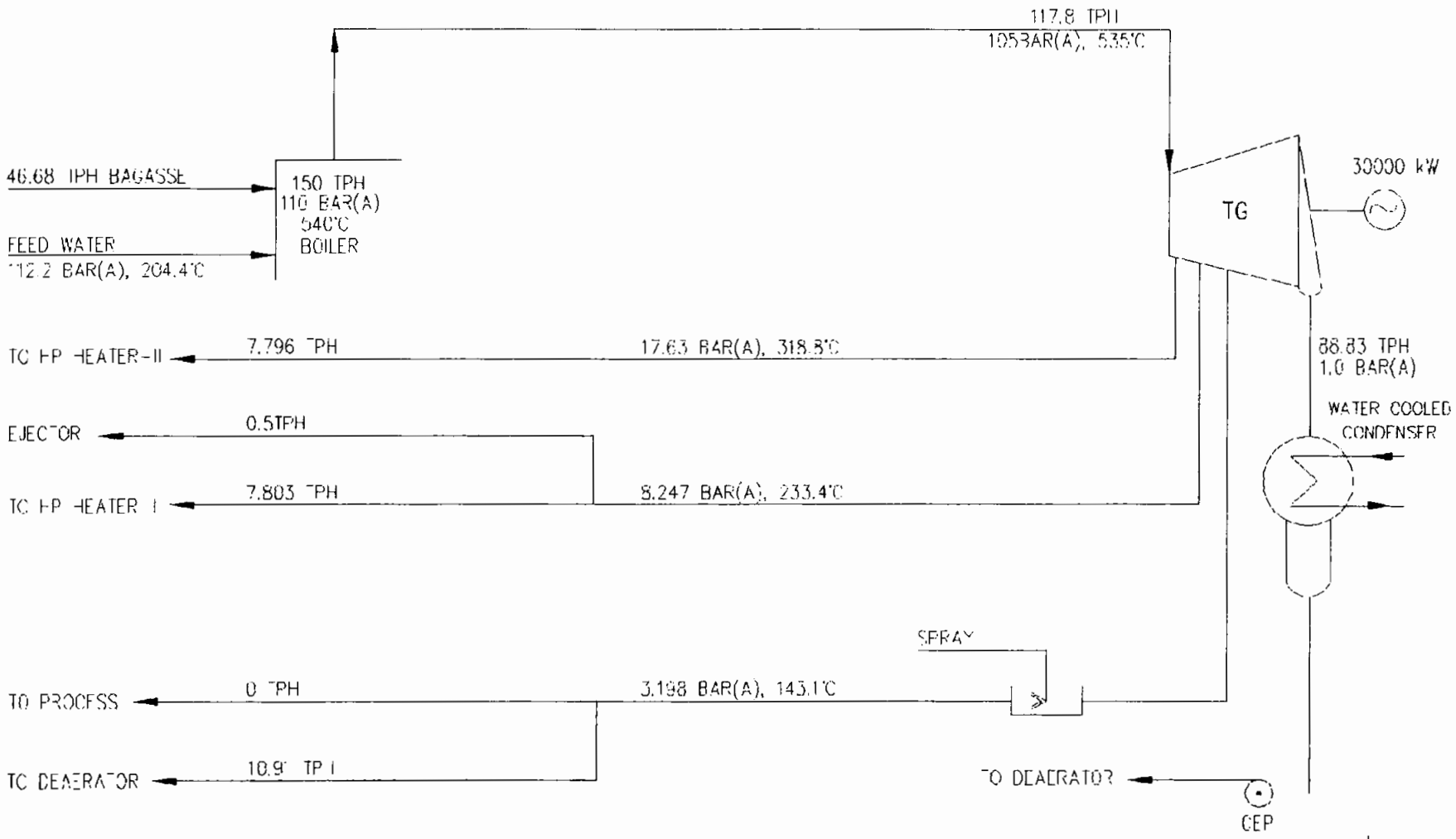

ENGINEERING CONTRACTOR: AVANT-GARDE ENGINEERS AND CONSULTANTS (F) LTD. CHENNAI 600 116, INDIA.	CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,	
	PROJECT	BAGASSE BASED COGENERATION PROJECT	
	PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE	
	TITLE	COGENERATION SCHEME – OFF SEASON OPERATION	

	NAME	SIGN	DATE
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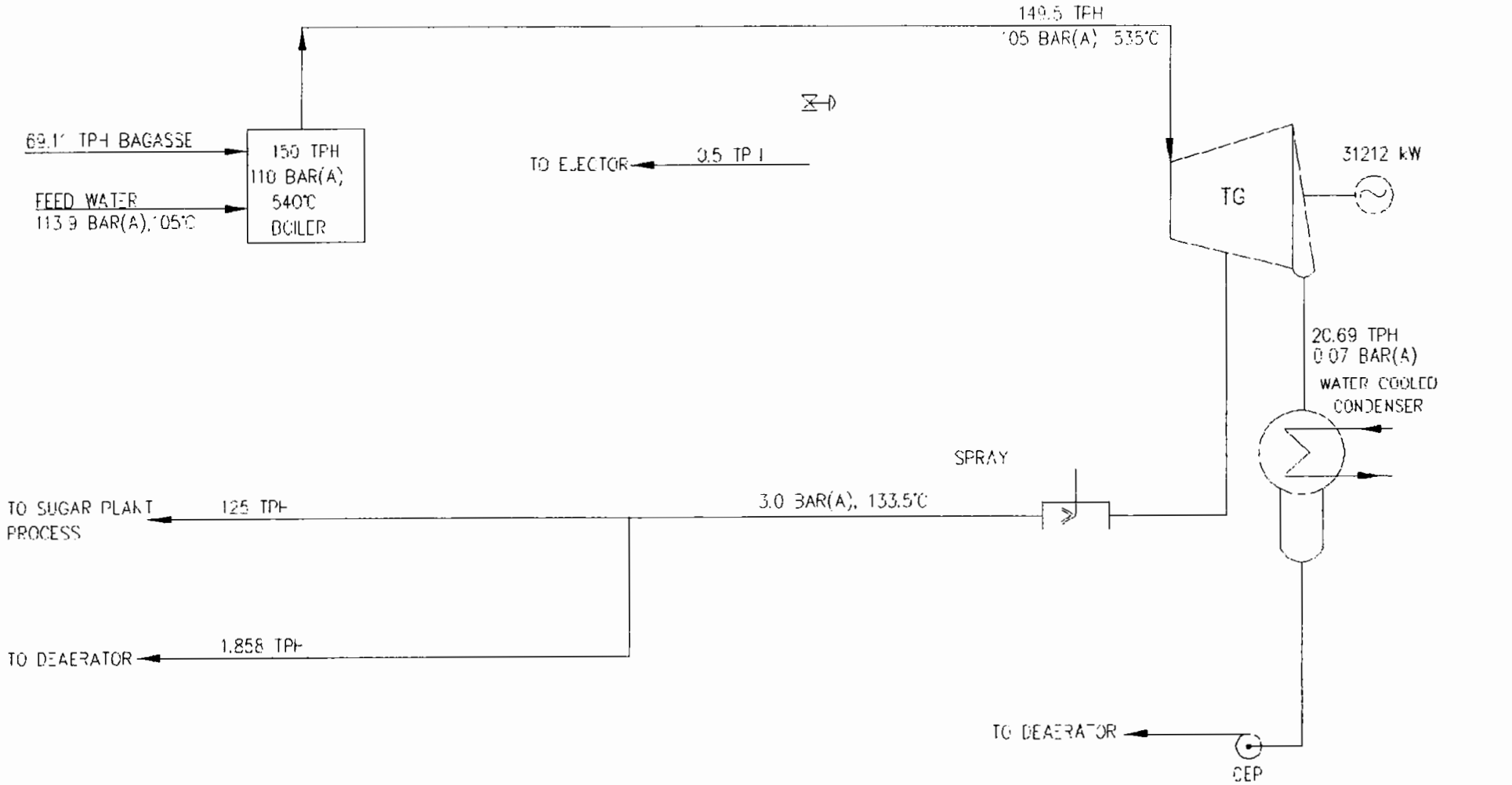
CHD	S.SIVAKUMAR		16.10.15
APPD	S.BALASUBRAMANIAN		16.10.15

DRAWING NO. NEW FIG.I.2 REV. 0

CAD DRAWING NO. 002

SIZE A4



110 BAR CYCLE
WITH OUT HP HEATER

ENGINEERING CONTRACTOR:
AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

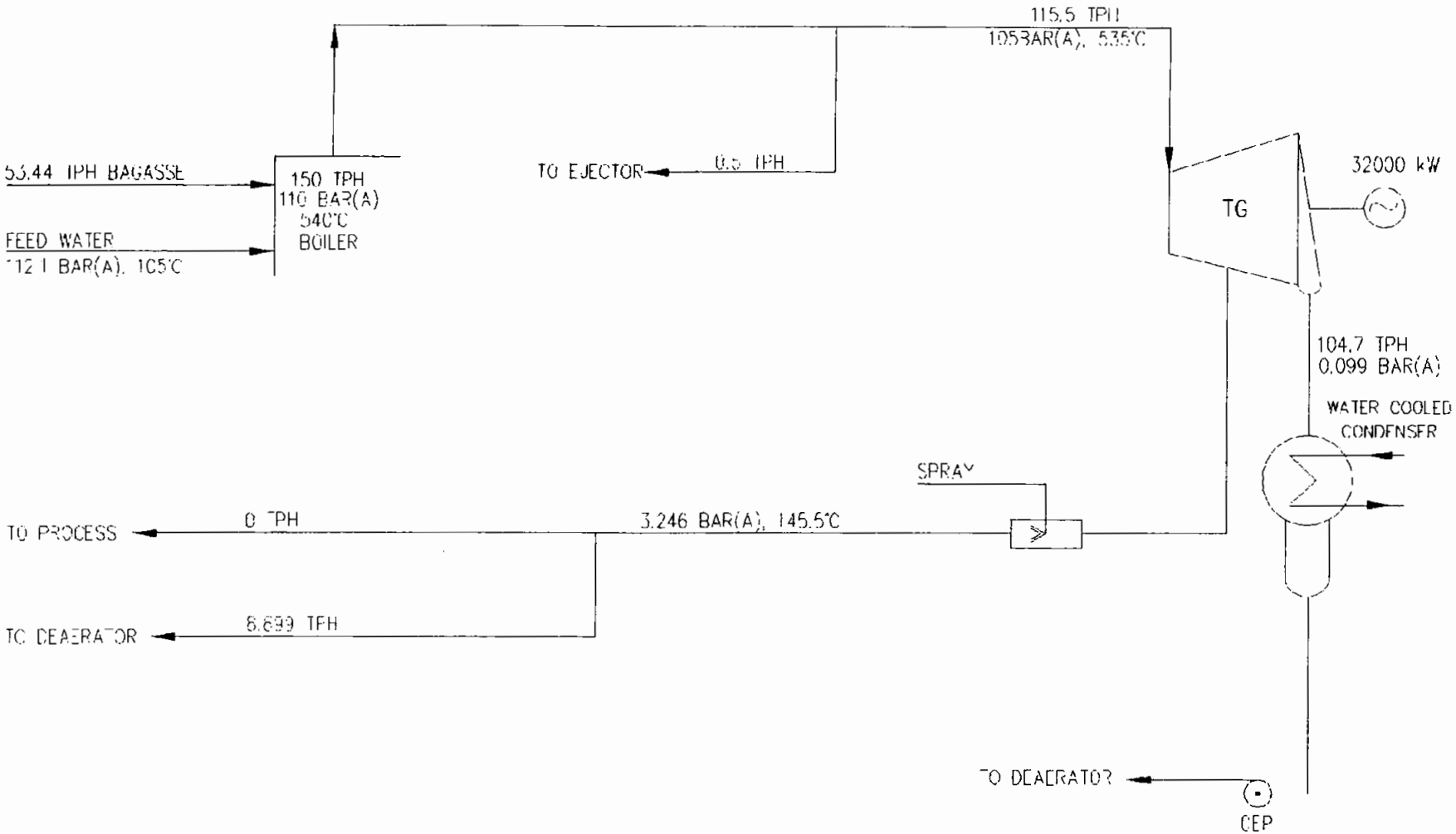
CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
TITLE	COGENERATION SCHEME – SEASON OPERATION

	NAME	SIGN	DATE
DRN	S.PRABHU		16.10.15
CHD	S.SIVAKUMAR		16.10.15
APPD	S.BALASUBRAMANIAN		16.10.15

DRAWING NO. NEW FIG.II.1 REV. 0

CAD DRAWING NO. 003

SIZE A4



110 BAR CYCLE
WITH OUT HP HEATER

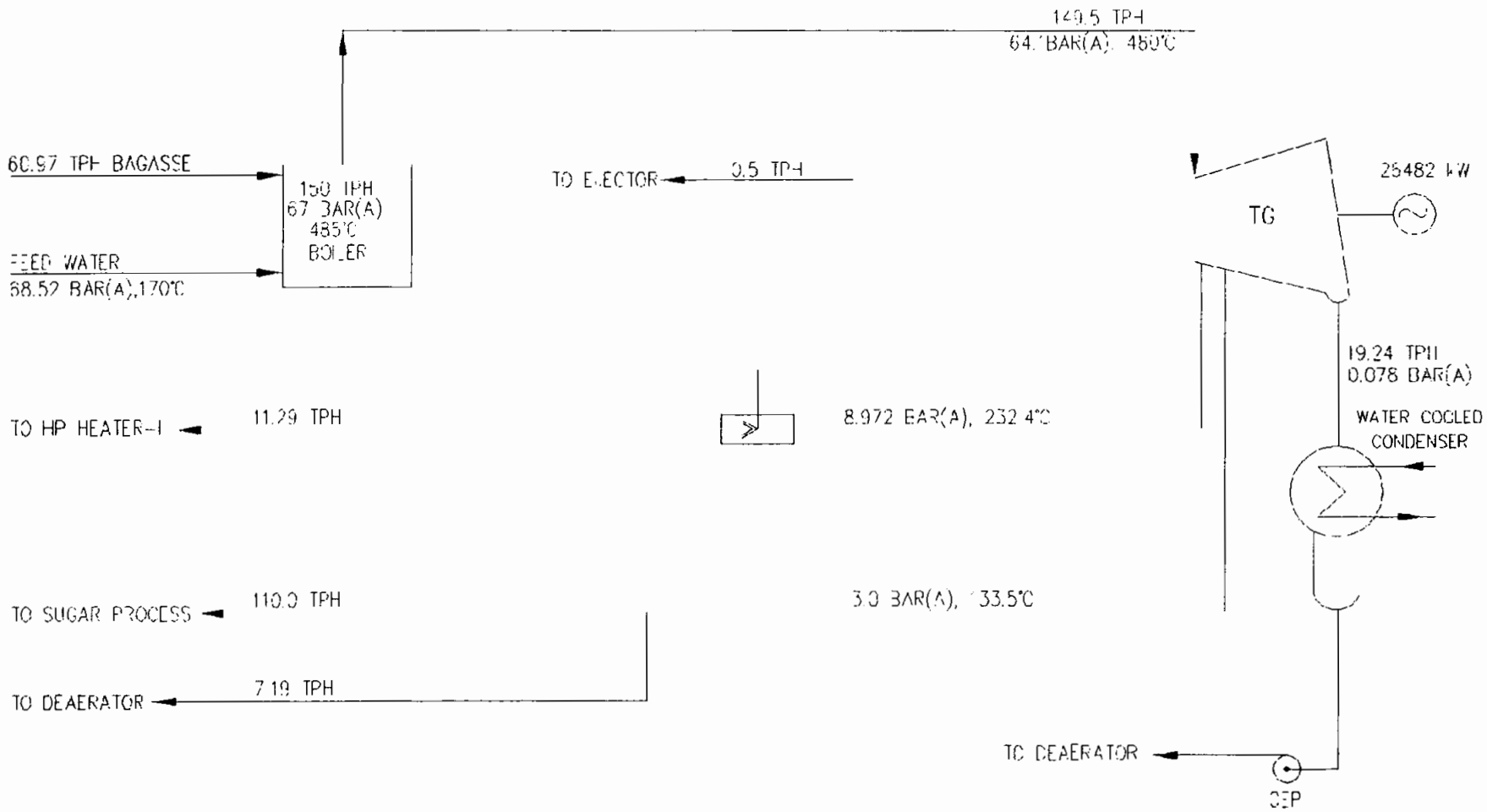
ENGINEERING CONTRACTOR:		
AVANT-GARDE ENGINEERS AND CONSULTANTS (P) LTD. CHENNAI 600 116, INDIA.	CUSTOMER	SHEIKHOO SUGAR MILLS LTD..
	PROJECT	BAGASSE BASED COGENERATION PROJECT
	PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
	TITLE	COGENERATION SCHEME – OFF SEASON OPERATION

	NAME	SIGN	DATE
DRN	S.PRABHU		16.10.15
CHD	S.SIVAKUMAR		16.10.15
APPD	S.BALASUBRAMANIAN		16.10.15

DRAWING NO. NEW FIG.II.2 REV. 0

CAD DRAWING NO. 004

SIZE A4



67 BAR CYCLE
WITH HP HEATER

ENGINEERING CONTRACTOR:
AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

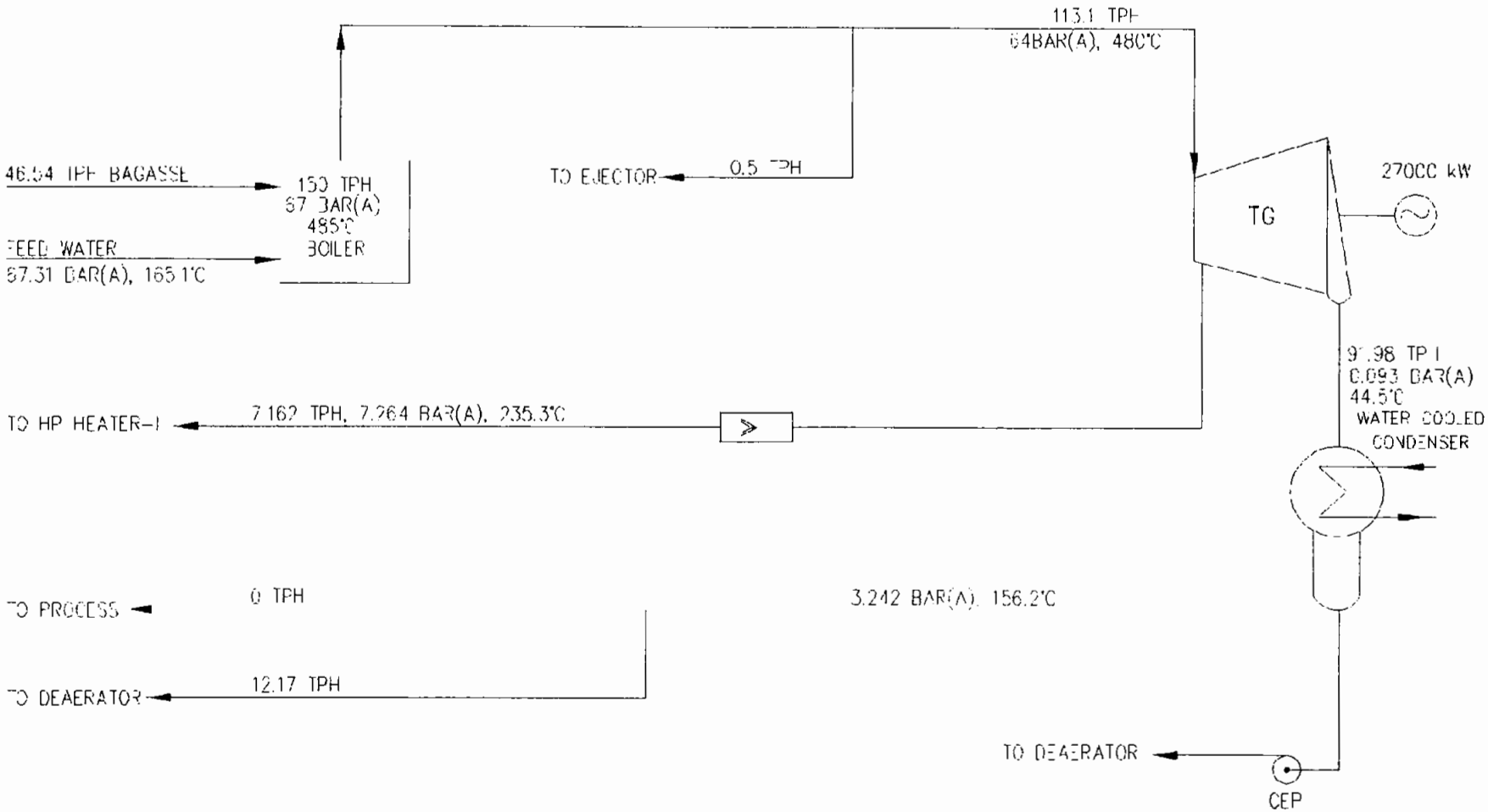
CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
TITLE	COGENERATION SCHEME – SEASON OPERATION

	NAME	SIGN	DATE
DRN	S.PRABHU		16.10.15
CHD	S.SIVAKUMAR		16.10.15
APPD	S.BALASUBRAMANIAN		16.10.15

DRAWING NO. NEW FIG.III.1 REV. 0

CAD DRAWING NO. 005

SIZE A4



67 BAR CYCLE
WITH HP HEATER

ENGINEERING CONTRACTOR:

AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
TITLE	COGENERATION SCHEME – OFF SEASON OPERATION

	NAME	SIGN	DATE
DRN	S.PRABHU		16.10.15
CHD	S.SIVAKUMAR		16.10.15
APPD	S.BALASUBRAMANIAN		16.10.15

DRAWING NO. NEW FIG.III.2 REV. 0

CAD DRAWING NO. 006

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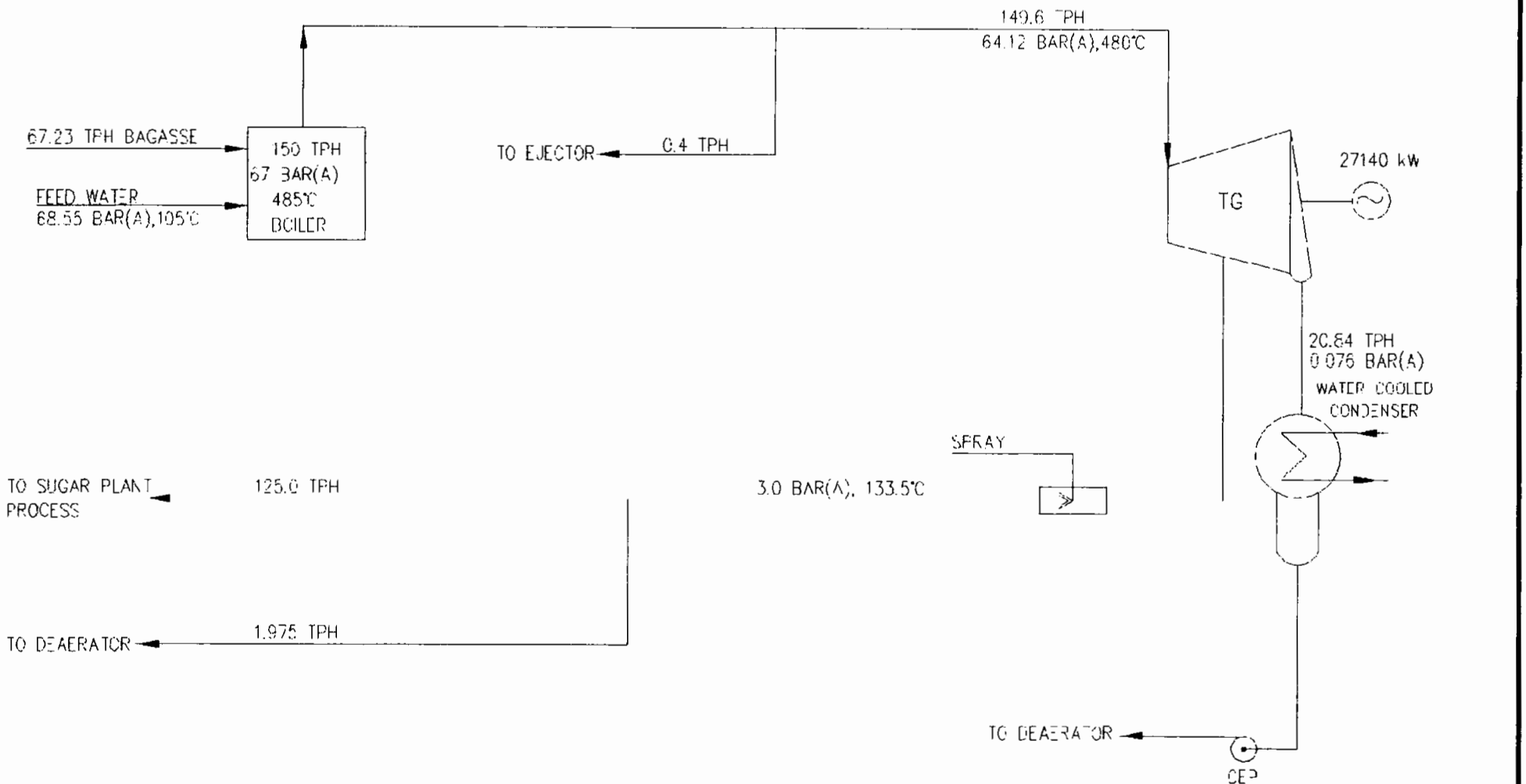


67 BAR CYCLE
WITH OUT HP HEATER

ENGINEERING CONTRACTOR:
AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

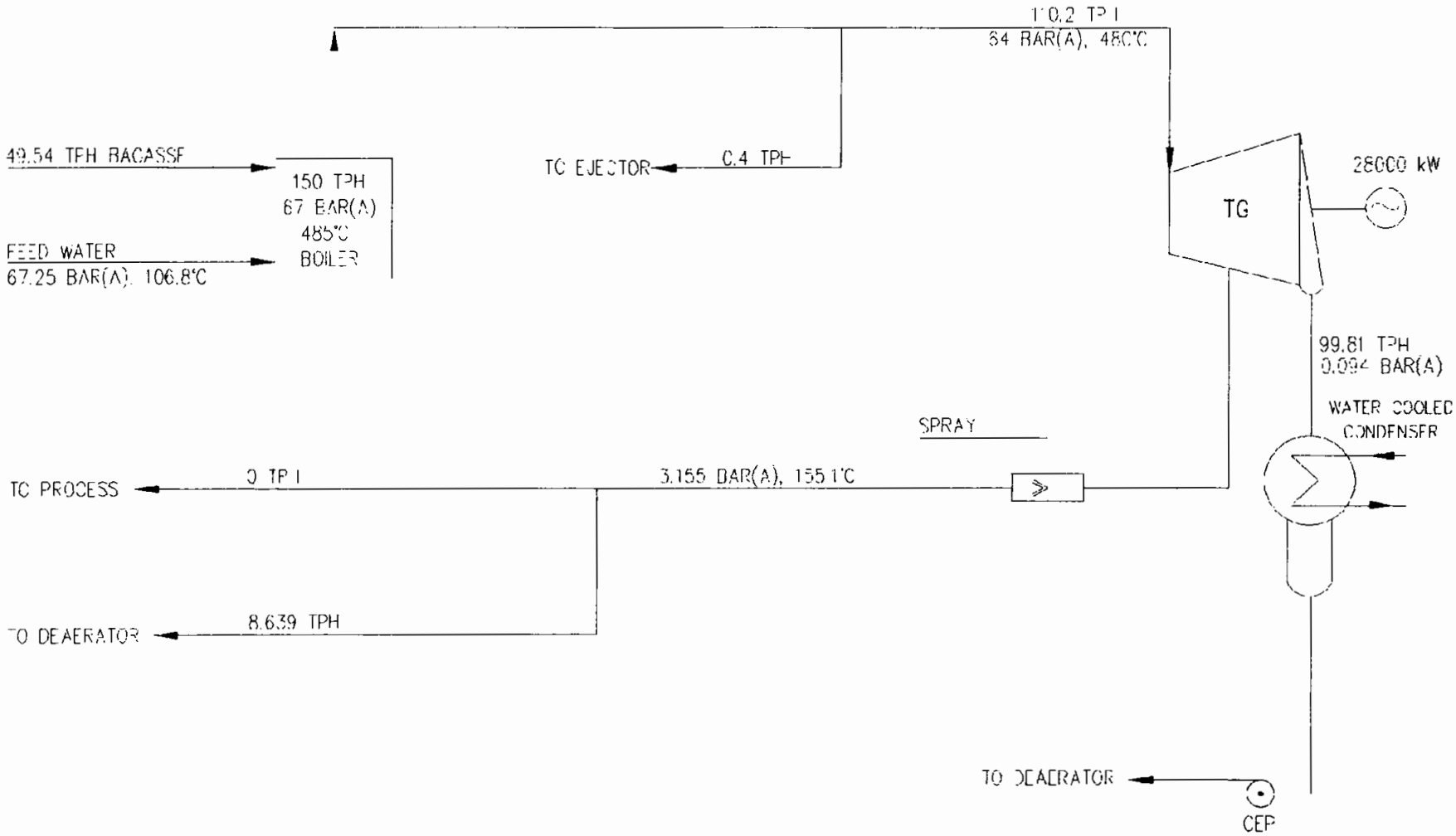
CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
TITLE	COGENERATION SCHEME – SEASON OPERATION

	NAME	SIGN	DATE
DRN	S.PRABHU		16.10.15
CHD	S.SIVAKUMAR		16.10.15
APPD	S.BALASUBRAMANIAN		16.10.15

DRAWING NO. NEW FIG.IV.1 REV. 0

CAD DRAWING NO. 007

SIZE A4



67 BAR CYCLE
WITH OUT HP HEATER

ENGINEERING CONTRACTOR:					
AVANT-GARDE ENGINEERS AND CONSULTANTS (P) LTD. CHENNAI 600 116, INDIA.	CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,			
	PROJECT	BAGASSE BASED COGENERATION PROJECT			
	PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE			
	TITLE	COGENERATION SCHEME – OFF SEASON OPERATION			

	NAME	SIGN	DATE
DRN	S.PRABHU		15.10.15
CHD	S.SIVAKUMAR		16.10.15
APPD	S.BALASUBRAMANIAN		16.10.15

DRAWING NO. NEW FIG.IV.2 REV. 0

CAD DRAWING NO. 008

SIZE A4

SHEIKHOO SUGAR MILLS LIMITED
MUZAFARGARH DISTRICT, PAKISTAN

CONCEPT PAPER

ON

BAGASSE BASED COGENERATION PROJECT

SEPTEMBER 2015

CONSULTANTS

AVANT-GARDE ENGINEERS & CONSULTANTS (FZC.)
EXECUTIVE SUITE, P.O.BOX 122632, SHARJAH, UAE

UAE

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Concept Paper on Bagasse Based Cogeneration at Sheikhoo Sugar Mills Limited (Crushing Capacity of 16000 TCD)

INTRODUCTION

Pakistan, a fast developing economy, needs to augment its electricity generation to power its development programs. The Government's power policy includes an ambitious agenda to increase the installed capacity, increase the generation from the existing plants, raise tariffs, improve the operational efficiency of the existing plants and support for power generation through alternative energy sources. Pakistan's National Policy for "Power Cogeneration by Sugar Industry" announced in January 2008, by the Government of Pakistan, was supposed to create a lot of interest in the Pakistan Sugar Industry. However the Policy which aimed at laying down clear guidelines on tapping the Cogeneration potential in the Sugar Industry did not evoke much of interest in the sugar Industry. The major points seen as the draw backs of that policy were the minimum size of 60 MW and the treatment of the Cogeneration plants as IPPs. The Government of Pakistan had a serious relook at the policy and a new policy had been announced in May 2013. This new policy had provided for an upfront tariff for the purchase of electrical energy from the Cogeneration plants and this policy is generally seen as the one encouraging the Pakistan's sugar industry to embark on the Cogeneration program without reservations. However this policy precludes the use of coal in these Cogeneration plants as an alternate or supplementary fuel. What is encouraging is that the substantial potential for grid quality power generation in the sugar mills has attracted considerable interest in Pakistan and both the government and the industry are discussing the best ways to harness this potential.

The energy crisis and the reality of global warming are already affecting the economy of many countries. The prevailing lower oil prices could give a sense of comfort to the planners that energy costs could be cheaper in the coming years. However everyone knows that the oil prices are suppressed due to many reasons than purely the economic reasons and the prices will start climbing up to higher levels. Oil is also a fossil fuel and its usage along with coal, irrespective of its

economic impact will definitely affect the environment. The likely negative impact on the sustainable development by the Green House Gas (GHG) emissions, from the usage of fossil fuels, is causing worldwide concerns. The major concerns in the developing countries, like Pakistan and India, today are the rapid growth in population, urbanization and fossil fuel consumption. It is important for any country, that the objectives of natural resource conservation and environment protection are integrated with the overall development process. The strategies to achieve the above objectives are encouraging fuel efficiency and preventing wasteful energy use and promoting technologies using renewable natural resources such as bio-mass, wind and solar energy.

Cogeneration, one of the energy conservation measures that uses fuels much more effectively and efficiently, has become the most convenient and environment friendly ways of generating grid quality electricity. The world over, Cogeneration has been recognized as a reliable way of generation of electricity. Even though many process industries like Chemical, Cement, textile etc., have the potential for Cogeneration, the Cogeneration projects in sugar mills offer the double benefits of Cogeneration as well as the use of renewable energy resource for power and thermal energy generation. Another major advantage with bagasse based Cogeneration is that the fuel for the operation of the plant is available within the plant premises and there is no need to transport the fuel to the plant.

COGENERATION

Cogeneration is defined as the concurrent generation of useful thermal energy and Electrical power from the same input fuel. Systems which supply heat energy, meets cooling demand and also produce electric power are called Trigeneration systems and they are also becoming popular. Any process plant requiring steam for processing, the pressure of steam required for most of the process applications being low, holds very good potential for Cogeneration of Power. The low pressure steam requirement for the process enables us to adopt a topping cycle Cogeneration system wherein the high pressure steam is first used for power generation and the low pressure steam exhausting the turbine is sent to the process. A Cogeneration system employs high pressure and high temperature steam and the advantage of additional power generation comes from the expansion of the high pressure and

high temperature steam to the required lower pressure, (as required in the process application) in a steam turbine. With the process steam parameters, dictated by the processes and remaining constant, increasing the turbine inlet steam pressure and temperature enhances the cycle efficiency and hence improves the power generation. For example, while the enthalpy of 23 bar(a) and 350 Deg.C steam is 3132.4 kJ/kg, the enthalpy of 110 bar(a) and 540 Deg.C steam is 3464.6 kJ/kg and for an increase of about 10% of the heat content in steam, there is more than double the quantum of power generation with 110 bar(a) system than with the 23 bar(a) system. Such is the potential with high pressure Cogeneration systems.

COGENERATION IN SUGAR INDUSTRY

In Industrial Cogeneration, the Sugar Industry occupies a prominent position as it employs a large quantum of thermal energy in the process. The thermal energy is supplied by the low pressure process steam, mostly with the parameters of 2.5 bar (a) and 130 Deg.C. All the thermal energy is used in heating and concentrating the juice to make the juice into syrup which will be suitable for crystallization. With the large quantum of low pressure steam usage, the sugar Industry stands as an ideal candidate for Cogeneration. In fact, Cogeneration has always been practiced by the sugar mills for a long time. All the power and process steam requirements of the sugar mill are met from the Cogeneration plant. However, hitherto, the generation of electricity had been limited to meet the operational requirements of the sugar mill and no surplus power is produced. Until recently, most sugar mill boilers and the power houses were designed primarily to meet the process steam and electricity needs of just the mill. With the power generation restricted to the mill's own in house requirements and with large thermal energy requirements and comparatively lower electrical power requirements, the boilers and Turbogenerators employed were mostly of the low pressure and low temperature type. There has been, of late, increasing awareness in the sugar industry of the advantages of installing high pressure, high efficiency bagasse based Cogeneration systems, to augment the power generation. The bagasse based Cogeneration affords numerous advantages as given below:

- The bagasse based Cogeneration is environmentally benign, and does not add to the existing pollution levels of the environment. This is mainly because of the

carbon recycling. Thus there is a justification for these projects from the point of view of greenhouse gas emission reduction and sustainable development.

- Saves on the consumption of fossil fuels. There is no need to transport the fuel to the generating station as the fuel, which is the bagasse, is generated within the sugar mill from the cane crushing operations of the mill.

- As the bagasse based Cogeneration plants will be located invariably in the rural areas, far away from the utility plants, the transmission and distribution losses are minimized. In addition these plants, generating and supplying the power at almost the fag end of the transmission systems, increase the quality of power supplied to the rural areas.

- There is a definite advantage with regard to the mobilization of the investment from private /Co-operative sectors in addition to the Government's budgetary allocations for the power sector. Because of the size and simplicity, these projects have shorter gestation time and power export to the grid could be realized in a shorter time compared to the utility plants.

- These projects present possible business opportunities for the sugar mills from CDM and sale of Renewable Energy Certificates etc.

- Brings in an overall energy discipline in the sugar mill. All efforts being made now, to reduce the steam consumption in the process, are born out of the desire to make the process energy efficient and to maximize the power export from the Cogeneration plant.

PRESENT STATUS OF COGENERATION TECHNOLOGY

The bagasse based Cogeneration plants operate on the Rankine Cycle, which is predominantly used in most of the steam based thermal power plants. High pressure and high temperature cycles are crucial for increasing the operating efficiency and the power output from the Cogeneration Plants. Thermodynamically, energy recovery from the Rankine Cycle is more dependent on the steam inlet temperature than the pressure and the higher the inlet steam temperature, higher the cycle efficiency. However owing to the peculiar properties of steam and water,

to extract the maximum energy from steam, it is necessary to appropriately increase the pressure of steam while increasing the temperature of steam.

Nevertheless, the practically attainable limits of temperatures are influenced by the metallurgy of the boiler tubing, piping and the turbine components and the complexities of the Creep fatigue interaction for the materials at higher temperatures.

The bagasse based Cogeneration technology has grown steadily over the last two decades. From the level of 24 bar(a) and 350 Deg.C, the steam parameters had been steadily increased to come to today's level of 125 bar(a) and 545 Deg.C. Many plants were built, in the early nineties with the parameters of 64 bar(a) and 480 Deg.C. The plants that went into successful operation showed that the sugar industry Cogeneration was a reality and the sugar mill and the country could get benefitted by this concept. After the successful operation of many of those plants for a few years, the steam parameters for the subsequently designed plants were raised to about 87 bar(a) and 510 Deg.C. In Reunion Island and in Hawai, plants with 80 bar(a) and 510 Deg.C had been built even in the early nineties. After getting adequate experience with 80 bar(a) systems, many plants are now being designed with 110 bar(a) 540 Deg.C steam parameters. With more number of operating plants with 110 bar(a) 540 Deg.C Cogeneration systems, new plants are being built with the steam parameters of 125 bar(a) and 545 Deg.C. It is understood that Reunion Island has also built a plant with 125 bar(a) and 540 Deg.C steam parameters. A large number of plants (more than two dozen) that had gone into operation with 110 bar(a) and 540 Deg.C steam parameters, in India, have performed well and efficiencies have been proven to be as predicted and better than the 80 bar(a) systems. The oldest of the 110 bar(a) 540 Deg.C plants has been in operation for the past Nine (9) years. The oldest of the 125 bar(a) 545 Deg.C Cogeneration plant has been in operation for the last four (4) years. All the efforts to increase the cycle parameters as discussed above had paid rich dividends by way of increasing the tapping of more and more energy from the same quantum of bagasse.

Apart from the increase in the cycle parameters, there had been a lot of improvements in the design of the system and equipment, including the auxiliary

equipment, for the Cogeneration plants over the years. In order to improve the efficiency of the cycle, regenerative Rankine cycle had been adopted with the introduction of high pressure feed water heaters in the boiler feed water circuits. The feed water entering the boiler economizer is heated, to about 210 Deg.C, in the high pressure feed water heaters for the 110 bar(a) system. This temperature goes upto 240 Deg.C in the 125 bar(a) systems. A lot of automation had been brought about for the optimization of the operation of the plant and most of the rotating equipment are designed with variable frequency drives (VFD). The usage of VFDs has brought down the auxiliary power consumption of the Cogeneration plants from the earlier levels of 12% to the present levels of less than 9%. As the quality of the feed water to the high pressure boilers is very important from the point of view of plant operational efficiency and availability a lot of care has been taken in the design of the water treatment plants. Membrane based water treatment systems have been extensively used and they have been proved to be operationally efficient, accommodating the deteriorating raw water qualities, economically attractive on life cycle costs, compared to conventional resin based de-mineralization plants. From the point of view of the environmental protection also the membrane based systems are better as they use much less quantities of acids and alkalies compared to the resin based systems that used large quantum of the acids and alkalies for the resin regeneration.

The experience so far has shown that there are no technical barriers for the design, construction and operation of the high pressure and high temperature Cogeneration systems in sugar mills. As many plants are in operation, mills now embarking on Cogeneration, need not have to worry about the point whether the technology is proven. However the same experience has also shown that prudent operating practices are required to ensure high efficiency and high availability of these plants. With the cost of energy increasing, it is only prudent that the available energy sources are put to better use by going in for the latest and efficient technologies and at the same time taking care of the stringent requirements of reliability, operation and maintenance.

In addition to the above, the choice of the level of the pressure and temperature for the cogeneration cycle depends on the current technological levels in the industry, level of confidence in the plant operators, quality of the feed water and the water treatment systems proposed, the cost of the high pressure boiler and

Turbogenerator systems and the financial benefits realizable from the Cogeneration plant, by way of the sale of exportable power.

GENERAL DESIGN PHILOSOPHY

The most important requirement of the Cogeneration plant is that the plant should operate in synchronization with the sugar mill, catering to the steam and power requirements of the sugar mill under all the operating conditions. The introduction of the Cogeneration system should in no way affect the operational reliability or the efficiency of the sugar mill. The two main equipment of the Cogeneration plant are the boiler and the turbogenerator and the selection of the type and size of these equipment depend on the design philosophy of the plant. Issues relating to the season and off-season operation, fuels to be used for the plant operation, minimum and maximum size of the plant, type and sizing of the boiler, type of the Turbogenerators (back pressure and extraction condensing) and sizing of the turbogenerator are to be adequately addressed while finalizing the design philosophy of the plant. Some of the salient points relating to the above are discussed below.

Season and off-season operation:

A sugar plant is a seasonally operating plant and a Cogeneration plant designed to cater to the steam and power requirements of the plant should operate as long as the sugar mill operates. The number of days of operation of the sugar mill varies depending on so many factors and more the number of days of operation it is better for the viability of the Cogeneration plant. A Cogeneration plant operating during the season and shut down during the off-season may not be a good business proposition, mainly from the point of view of the investment and utilization of the assets. If there is no off season operation, the tariff should sufficiently be attractive such that the project becomes financially viable even with the plant operating only during the season. Designing the plant to operate round the year is the best option as the electricity companies who purchase the power also look for round the year and firm power availability from this plant. Eventhough the current policy of the Government of Pakistan and the consequent tariff fixation is based on a plant load factor of 45%, it is in the interest of the power starved country that the power generation facility is utilized year round. As there will be no requirement

of steam and power for the sugar mill operation during the off-season, the Cogeneration plant essentially will be operating as a power plant, just generating electrical energy but not generating any thermal energy for the process plant operation.

Fuel for the operation of the plant

The major advantage of the bagasse based Cogeneration plant is the availability of a good fuel like bagasse at the plant premises. Eventhough the milling operation produces the bagasse with 50% moisture, the nature of the fuel is such that it burns comfortably with the 50% moisture without any support fuel. The fuel value of One Metric Tonne of 50% moist Bagasse is approximately equivalent to that of two barrels of fuel oil. The heating value of Bagasse, with 50% moisture, is higher than some of the brown coals found in the world. As long as the sugar mill operates, all the bagasse generated in the crushing operations will be made available to the Cogeneration plant. While sizing the plant the options available are:

1. To use all the bagasse during the season operation and find some other fuel for the off-season operation.

2. Go for the minimum size of the plant and save the balance bagasse for atleast a few days of operation in the off-season. Find other fuels for the operation for the balance of the days in the off-season.

The option (2) above is preferred, as this option reduces the investment on the plant because of the smaller size and prolongs the operation with bagasse which makes the project more economically viable. The Option (1) above has the double disadvantages of higher capital investment due to the bigger size of the plant and more bought out fuels for the operation during the entire off-season.

The fuel for the off-season could be any other compatible bio-mass fuel like cane trash, rice husk, etc., depending on the availability. The plant could also be designed for operation with coal. The logistics of collection and transportation of the bio-mass fuels restricts the quantity of bio-mass fuels that could be used in the Cogeneration plants. However bio-mass fuels could always be used in the plant subject to the condition that the fuel characteristics are acceptable to the boiler

with higher steam parameters. If the sugar mill can manage the cane trash collection, it can be a good supplement to bagasse, but however, it is better if the same is used during season and corresponding quantity of bagasse saved for off-season operation. So, for all practical purposes, the off-season fuel for the Cogeneration plant, other than the saved or bought out bagasse, could be a compatible bio-mass fuel like rice husk or coal. Considering the high silica in the rice husk ash and the consequent possible erosion damage to pressure parts, it is always better to use the rice husk, not as a standalone fuel but always along with bagasse.

Usage of coal in the Cogeneration plant should be restricted as the heat rate in the best designed Cogeneration plant could be higher by about 40% to 50% compared to the heat rate of larger utility plants. The comparison of the gross heat rates (on HHV) show that, while the heat rate of the best designed Cogeneration plant, operating under power generation mode, could be 3100 kCals/kwhr, the heat rate of a 300 MW capacity utility plant using the same fuel could be 2200 kCals/kwhr. Apart from being inefficient, the smaller plants let out more green house gases per unit of electricity supplied to the grid. Coal, which is an exhaustible fossil fuel, should be used with care and it is better utilized in higher capacity utility plants. It is good for the country, if the scarce energy resource, procured at a higher price and in some cases using the precious foreign exchange, is not used inefficiently. NEPRA, in disposing off an earlier tariff petition, had aptly observed "If the objective is increasing the usage of coal based electricity in the generation mix, a better option would be to construct larger coal based power plants". There could be no other justification, except the following, for using coal in these Cogeneration plants.

1. To utilize the asset, instead of keeping it idle for a substantially longer period in a year. The huge investment made in the Cogeneration plant will remain idle if the plant is not used during the off season. This also could be done only if it is economical to operate the plant with coal.

2. To help the country to tide over a deficit power situation. Here again it is justified only if the benefits of power generation with coal (like contributing to the economic development of the country) far outweigh the higher cost of generation with coal.

So, the inference from the above, under normal circumstances, shall be that the Cogeneration plant should be basically designed for operation, using the bagasse generated in the sugar mill and coal usage should be incidental. It is better not to create an asset, which will use a scarce fuel like coal inefficiently all the time. Compatible bio-mass fuels could be used as supplementary fuels and the sugar mill, through a fuel department (similar to the cane department), should always look for compatible bio-mass fuels and procure and store them as and when they are available at affordable prices.

Under the power deficit scenario in Pakistan, sugar mills should approach the Government to get permission for the use of coal in these plants atleast till such time the higher capacity supercritical coal fired plants, being proposed by the Government, come up meet the country's total requirements of power.

This concept report discusses the operation of the plant with coal firing in the off-season. Even though the coal firing is not presently allowed in these cogeneration plant, by the policy, considering the precarious power position of the country, it is expected that the coal firing could be permitted at least for a definite period of time. In order to make an investment decision, the report gives the cost of the plant with and without coal firing equipment and also gives the exportable energy with coal firing and without coal firing.

Minimum and Maximum Size of the Cogeneration Plant

The minimum size of the Cogeneration plant depends on the steam and power required by the sugar plant. The steam requirement of the process, the minimum flow to the condenser of the turbine and the minimum steam flow to the heaters and deaerator dictate the minimum size of the plant. For a sugar mill of specific capacity the minimum size of the Cogeneration plant depends on the process steam requirements. It is obvious that with minimum process steam demand, the Cogeneration plant size will be smaller and with less investment. There is no limit on the maximum size of the plant, provided adequate and acceptable fuels could be found for operating the plant. However, this should be decided based on the points discussed earlier under **"Fuel for the operation of the plant"**.

Type and size of the boiler

One of the two most important equipment in a Cogeneration plant is the boiler. This equipment is important even from the point of view of the operation of the sugar mill, as this equipment is the main energy provider for the operation of the sugar mill. When the Cogeneration plant is being designed for year round operation, it is essential that the boiler is designed and constructed to give the utmost reliability in operation. Selecting the type of boiler depends on the fuels to be fired and the economics. A boiler firing just bagasse could be a spreader stoker boiler with dumping grate or pin hole grate or pusher grate. However the boiler using these firing systems will not be suitable for firing coal. If the boiler is expected to fire bagasse and coal, it is advisable to select a spreader stoker boiler with a travelling grate. Travelling grate offers the flexibility to use either bagasse or coal or a combination of bagasse and coal (not an advisable combination) and a few other bio-mass fuels. However a travelling grate fired boiler suffers in efficiency, specifically under coal firing, compared to its other modern rivals like Atmospheric Fluidized Bed Combustor (AFBC) Boiler, or Circulating Fluidized Bed Combustor (CFBC) Boiler or a pulverized fuel (PF) fired boiler. AFBC and PF boilers are not suitable for bagasse firing and CFBC boilers will need coal support for firing bagasse, on a continuous basis. This will mean that the sugar mill will depend on a bought out fuel like coal even during the crushing season operation, which will not be a comfortable situation.

A boiler designed to fire both 100% bagasse and 100% coal will be much bigger in size, mainly from the point of view of differing furnace absorptions with these fuels and differing permissible furnace gas outlet temperatures. It is always better to restrict the steam generation with coal to about 75 to 80% in a boiler designed for firing 100% bagasse.

Unlike a PF or CFBC or even AFBC boiler, the travelling grate boilers have a limitation on the size. This limitation comes out of the reliable operation of the critical moving part which is the grate. One needs to take into account the grate heat release rates, requirement of uniform spreading of the fuel on the grate, draft loss across the grate and grate metal temperature while dealing with two different fuels like bagasse and a high calorific value fuel like coal. Broadly for

such applications it may be advisable to restrict the size of the boiler to about 200 to 220 TPH. As the reliability of boiler operation depends on the performance of the travelling grate, it is better to be conservative in selection, even though some of the boiler manufacturers could claim that they could manufacture boilers of higher capacity with travelling grates. As this travelling grate is critical equipment, utmost reliability and trouble free operation over many years should be the criteria for the selection of the equipment.

Backpressure and Extraction Condensing Turbogenerators

While the option of selecting a backpressure turbogenerator is available, this option needs to be carefully exercised as the power generation in a back pressure turbogenerator is incidental to the process steam flow and the operation of the plant during the off-season is not possible. Hence, as long as the requirement is to generate power round the year, it is essential that the plant is designed with an extraction condensing turbogenerator. There is another advantage with the controlled extraction turbines, which is its ability to maintain a steady extraction steam pressure, which is supplied to the process and this reduces the process steam consumption by some percentage points. However, if the sizing is done in such a way that the backpressure machine is loaded fully under all the operating conditions, then also the specific advantage, of steady process steam pressure, mentioned above could be realized. However in a sugar mill scenario, where the process steam fluctuations are endemic, it may be difficult to employ a back pressure TG in a Cogeneration plant which will be expected to supply both firm capacity and energy to the grid. Looking at the selection of the turbogenerator form the point of view of the existing Cogeneration policy, it is essential that an extraction condensing turbogenerator is chosen since the policy expects a firm power supply to the grid. Also it is in the sugar mill's interest that the plant operates round the year or atleast for a substantial number of days in the off-season to get a better payback on the investment and that necessitates the selection of an extraction condensing TG.

Size and Features of the Turbine

The turbine designed for a bagasse based Cogeneration application is vastly different from the one designed for other applications, mainly because of the large steam flow difference between the season and off-season operating conditions in

some sections of the turbine. During the season operation where the turbine is expected to provide a large quantum of extraction steam to process the steam flow in the turbine downstream of the extraction port will be the minimum and the flow in the same section during the off-season mode will be the maximum. The Low pressure section steam flow in off-season could be four to five times higher than the steam flow in the season operation. This specific requirement of a Cogeneration turbine poses a challenge, albeit surmountable, to the designers. There is a lot of iteration involved in the design to arrive at the optimum performance both during the season and off-season operating conditions. Other than the above, there is really no limitation on the size of the machine. Another important point in the turbine sizing is that the capacity of the turbine is decided based on the season operation and for the off-season operation the steam flow to the turbine is reduced from the season flow and the boiler operates below the MCR capacity. Another methodology of sizing is that the turbine could be sized for a higher capacity, considering the MCR generation of the boiler and with no process steam extraction during the off-season. However, this methodology will result in reducing the turbine efficiency during the season operation, due to the operation at lower load and also due to the vast difference in the steam flow in the LP sections between the season and off-season operation.

The turbine could be an impulse or reaction machine with inlet throttle control. Each have its own minor advantages and disadvantages, but however on the overall, either of the two is acceptable. The machine could be with gear box, but however for sizes 40 MW and above a direct coupled machine without the gear box will be preferred. The low pressure extraction required for the sugar process shall be through a controlled extraction. The turbine could have additional bleed points for bleeding the steam for regenerative feed water heating. The condenser of the turbine could be either water cooled or air cooled and shall be capable of handling the maximum steam flow under the off-season operation mode.

Process Steam requirement of the sugar mill

Process steam consumption in the sugar mill is one single entity which affects the design and operation of the Cogeneration plant. As seen earlier the minimum size and hence the investment in the Cogeneration plant is dependent on the process steam consumption. More the process steam consumption more energy from bagasse

is supplied to the process plant as thermal energy and less will be available for conversion to electrical energy. As energy is a major component of the production cost of any commodity, it is advisable to seek better technology and reduce the energy consumption in the process which will optimize the sizing of the Cogeneration plant. Reduction in the process steam enables, apart from downsizing the plant, saving of a lot of bagasse which could be used for extending the number of days of operation in the off-season.

FEED WATER MANAGEMENT

One of the most important aspect of the Cogeneration plant operation is the feed water management. While there are advantages in going with higher pressure cogeneration cycles there could be serious problems if the requirements of effective feed water management are not taken care of. The feed water quality requirements for higher pressure boilers are more stringent in terms of permissible silica, iron, copper and other mineral contents. At higher pressures, the percentage of drum water silica going as vapourous carry over is high and this increases with the increase in the operating pressure. This vapourous carry over of silica could cause severe scaling in the turbine blades if not controlled. The silica deposition in turbines takes place not in the high temperature sections but in the relatively lower temperature sections.

While it is easy to treat the raw water to the required quality levels in a suitably designed water treatment plant, the problem comes only with the condensate returned to the Cogeneration plant from the sugar mill process house. As the quantity of the condensate returning is quite high, the Cogeneration plant cannot afford to reject all the condensate at all the time and make up all the requirements from the DM plant. Also the heat content in the return condensate is quite high and without effective utilization of the heat energy in the condensate, the plant efficiency suffers. In the high pressure Cogeneration plants, the usage of the vapour condensate, from the sugar mill, is prohibited as boiler feed water make up. Only the exhaust condensate, i.e. the condensate of the steam supplied from the Cogeneration plant to the process house will be used as boiler feed water. Even this condensate will be monitored for contamination before admitting the same to the feed water circuit of the Cogeneration plant. If contamination is detected in the return condensate from the sugar mill, the condensate will automatically be

diverted and will not be used as boiler feed water. Continuous monitoring of the quality of this condensate is required for the reliable trouble free operation of the Cogeneration plant. The sugar mill process equipment reliability and a constant vigil of the sugar mill operators are required, for ensuring that the quality of the return condensate is maintained suitable to the Cogeneration plant's requirements.

It is worth re-emphasizing the importance of supplying contamination free condensate to the Cogeneration plant from the sugar mill. The condensate tank receiving the steam condensate (mostly the first body condensate) shall be isolated without any interconnection with the second body calandria vapour space for flash steam recovery. Many sugar mills have put up flash steam recovery systems to reduce the process steam consumption on cane. As there is a potential for the contamination of the steam condensate through this flash steam interconnection, once the Cogeneration plant is implemented, there shall be no flash steam recovery from the first body steam condensate.

The makeup water, for the plant operation, will be treated demineralised water and a new water treatment plant of adequate capacity shall be installed. In case the high pressure Cogeneration plant is operated in parallel with an existing low pressure boiler due to the phased implementation of the Cogeneration project, it is imperative that the low pressure boiler shall also be supplied with the same quality of the feed water as the high pressure boiler. This is only to eliminate the possibility of contamination of the exhaust steam condensate when the steam from both the systems mix in the process house. The sugar mill should ensure contamination free condensate to the Cogeneration plant, as well as to the low pressure boiler operating parallel with the Cogeneration plant. Whatever modifications are required in the sugar mill equipment to meet with this requirement should be implemented. Alternatively the sugar mill can think of a steam transformer arrangement to meet with the condensate quality requirements.

COGENERATION AT SHEIKOO SUGAR MILLS LIMITED

Sheikoo Sugar Mills Limited (SSML) with the present crushing capacity of 16,000 TCD is located at 8 Km, Sanawan - Sultan Colony road in Muzafargarh Distt. of the Punjab province in Pakistan. The nearest airport to the plant is at Multan. The sugar

mill has a single) seven (7) mill tandem with all the mills driven by steam turbine drives. The fibrizer is driven by a 6000 kW steam turbine drive. The sugar mill has proposed to install falling film evaporators to optimise the process steam consumption from the present levels to the extent of less than 42% on cane. The plant is presently operating with a process steam consumption of around 48% on cane. As of now, the sugar mill generates, in-house, all the steam and power requirements for its operation from four (4) boilers each of capacity 80 TPH with the outlet steam parameters of 25 bar(a) and 350 Deg.C. The in house power generation with 3x3000 kW and 2x6000 kW turbogenerators. The sugar mill operates for an average period of 120 days in a season, between the months of November and March.. The company, using the new policy initiative by the Government of Pakistan would like to tap the Cogeneration potential in their sugar mill. This "Concept Paper" gives, in brief, the basis on which the Cogeneration scheme could be developed, the potential for Cogeneration and possible configurations for the Cogeneration plant.

Basis for Developing the Cogeneration Scheme

- The nominal cane crushing capacity of the sugar plant will be 16,000 TCD in 24 Hours or 667 Tonnes Cane Per Hour (TCH).

- There is no specific requirement on the minimum capacity of the Cogeneration plant and the plant sizing will be based on the sugar mill's steam and power requirements and the fuel availability.

- With regard to the cycle steam parameters for the Cogeneration plant, it is proposed to look at two alternatives. One is with the most modern and operationally proven cycle parameters of 110 bar(a) and 540 Deg.C and the other one is what is being currently used in Pakistan with the boiler outlet steam parameters of 67 bar(a) and 485 Deg.C.

- As discussed elsewhere, there are many plants successfully operating with the steam parameters of 110 bar(a) and 540 Deg.C and based on what is being used currently and widely, it is proposed that the boiler outlet steam parameters could be 110 bar(a) and 540 Deg.C. The feed water temperature entering the boiler economizer will be 210 Deg.C. The steam parameters at the inlet of the turbine throttle valve could be 105 bar(a) and 535 Deg.C.

- Considering the fact that 110 Bar(a) and 540 Deg.C cycle parameters are new to Pakistan, the other alternative looked at is with the parameters currently being used in Pakistan. The boiler steam outlet parameters will be 67 bar(A) and 485 Deg.C. Even though the currently designed plants in Pakistan with these parameters do not use regenerative feed water heating, with the view to optimize the cycle efficiency, the proposed schemes consider one high pressure feed water heater in the feed water circuit to get a final boiler feed water temperature of 170 Deg.C. The steam parameters at the turbine inlet will be 64 bar(a) and 480 Deg.C. The impact on the performance of the 67 bar and 485 Deg.C cycle with out the feed water heater, as is currently used in Pakistan, is also studied as a separate alternative.

- Both the 110 bar alternative and 67 bar alternative are studied with configurations consisting of two and three units. This gives options to SSML to go with the Cogeneration program in a phased manner.

- The 2.5 bar(a) process steam requirement for the sugar plant, will be 42% on cane. For a crushing of 667 TCH, the 2.5 bar(a) process steam requirement comes to 280.14 TPH. The temperature of the process steam will be around 130 Deg.C. With the implementation of the Cogeneration program it is imperative that most of the condensate of the steam supplied to the sugar mill is brought back at the maximum temperature possible. However conservatively, it is presumed that about 97% of the steam supplied to the sugar mill process will be returned, as condensate, to the Cogeneration plant at a temperature of 100 Deg.C. With the segregation of the exhaust steam condensate from the sugar mill's evaporator station and with the direct pumping of the condensate to the Cogeneration plant deaerator, without allowing flashing, the quantity of the condensate returned and the temperature of the condensate will be much higher than the numbers indicated above and will positively impact the cycle efficiency.

- In addition there will be a requirement of 8 bar(a) steam at 1 % of the crushing capacity and this works out to 6.67 TPH. There will be no condensate return from this stream. Even though this value of 6.67 TPH, seems to be quite high, for the purpose of this concept note this value is taken as such. However this should be discussed and agreed at the time of plant design. Some sugar mills,

with the view to eliminate this 8 bar (a) steam requirements have redesigned their system to accept 3 bar(a) steam and this will result some additional power generation in the Cogeneration plant turbogenerator. SSML may also look at the possibility of eliminating this 8 bar steam requirement which will have a positive impact on the efficiency.

- The bagasse percentage on cane is about 29.55 % and the quantum of bagasse generated per day would be 4728 MT. Fine bagasse, called bagacillo is required for the vacuum filters and the quantity required for this purpose and the losses is estimated to be 1.44% of the cane crushed. This 1.44 percent requirement comes to 9.6 MT/hr. The balance of the bagasse generated will be available for use in the Cogeneration boilers. This works out to a daily availability of 4500 MT or 187.5 MT per hour of bagasse for the Cogeneration plant.

- The motive power for the plant operation is presently being provided by the in-house turbogenerators and the steam turbine drives. The steam turbine drives are not energy efficient and while planning for Cogeneration, it is necessary that the turbine drives are retired. In all the alternative configurations proposed, the existing boilers, turbogenerators and the drive turbines will be retired after the installation of the new high pressure Cogeneration system in full to its final configuration. The mills and the shredder drives will be replaced by appropriate capacity AC electric motors and the mills will be driven by variable frequency drives. There will be no steam turbine drives in the plant subsequent to the commissioning of the Cogeneration plant.

- Even though, the existing boilers, turbogenerators and the drive turbines will ultimately be retired, as the low pressure systems are inefficient, the existing boiler and power turbines can be kept as stand by at least for the first crushing season after the full implementation of the Cogeneration plant.

- Sheikoo sugar mills Limited produces refined sugar and the power consumption of the sugar mill, exclusive of the power block, will be 26 kW per MT of cane crushed. This power consumption of 26 kW per MT of cane crushed is, slightly conservative and is easily achievable. Any increase in the consumption will negatively impact the exportable energy from the sugar mill. With 667 TCH of cane crushing the total electric power consumption will be 17,342 kW.

- The power generation in the Cogeneration turbogenerator will be at 11 kV level. The turbogenerators will be operating in parallel with the Grid. The exportable power will be stepped up in the generator transformer(s) to 132 kV, for paralleling with the grid at the MEPCO's grid sub-station, located at Kot Addu, at a distance of 25 Kms from the plant. The facilities at the grid sub-station for evacuating the exported power need to be studied in detail.

- The power requirements of the sugar mill and the Cogeneration plant will be met by appropriately stepping down the voltage in the distribution transformers. The number of distribution transformers will be decided based on the actual electrical power requirements.

- The proposed Cogeneration plant design is based on water cooled condensers. It is assumed that adequate water will be available for this condenser cooling application. The source of the raw water will be the sub-soil water from the tube wells . It is to be ensured that adequate quantity of raw water is available from the existing sources or additional sources shall have to be developed for meeting these requirements.

- The alternatives are presented assuming that the Cogeneration plant will be implemented in one phase. It is possible that the alternatives presented could be implemented in phases, with part of the existing boiler/TG/drive turbine systems in operation before the final phase of implementation. If such an alternative is chosen the number of old boilers and Turbogenerators to be operated along with one or two units of the high pressure Cogeneration plant need to be studied in detail. The implications of such an operation should be understood clearly as any mal operation could affect the operation of the high pressure Cogeneration plant.

- As discussed earlier, the aim should be to maximize the power generation from the plant using in-house bagasse with the appropriate sizing of the Cogeneration plant. However as the crushing days are only 120 days, it is essential that alternate fuels are identified for the year round operation of the plant. SSML has indicated that imported coal could be the auxiliary fuel for the operation of the Cogeneration plant. Even with imported coal, it is always advantageous to identify some bio-mass fuel that could be sourced comfortably in the plant vicinity so that the usage of coal in the plant could be minimized. It is

understood that some amount of cane trash and some rice husk could also be procured for extending the operating days of the plant. Both cane trash and rice husk could be used along with bagasse either during the season or during the off-season depending on the availability. It is advisable to undertake a survey to assess the collectible quantum of these fuels in the plant vicinity to estimate the possible additional number of days of operation with these fuels.

- The boiler could be designed to fire a few more bio-mass fuels, if they could be identified at the time of plant design. However the boiler will be designed to fire bagasse and imported coal. For the purpose of this concept note an imported coal with the HHV of 5625 kCals/kg (ash 15.36%, sulphur 0.75% and total moisture 17.5%) is assumed. The boilers will be designed to fire furnace oil or heavy fuel oil to generate a maximum of 30% of the MCR capacity. However the oil usage will be only on an extreme exigency and the boilers could be started up and operated without oil.

Cogeneration potential:

With 16,000 TCD crushing and considering 28.1% of bagasse as available for power generation, the annual quantum of bagasse that will be available for Cogeneration plant consumption, with 90% capacity utilization for the sugar mill and with an average of 120 days of crushing, will be 486,000 MT. Going with the concept of sizing the Cogeneration plant based on the sugar mill's steam requirements and with minimum flow to the condenser will result in a maximum plant size of 84 MW. This size of 84 MW will leave some marginal quantity of bagasse for off-season operation. However as discussed elsewhere, the plant sizing should be so as to extend the operation of the plant for more number of days during the off-season so that the project is viable.

A few Alternatives, as discussed later in this report, are looked at for the sizing of the Cogeneration plant for the Sheikhoo Sugar Mills Limited. These alternatives are prepared based on the points discussed in the section on the "Basis for developing the cogeneration scheme'. Two of the alternatives studied are based on 110 bar and 540 Deg.C steam parameters and the rest of the alternatives are based

on 67 bar and 485 Deg.C steam parameters. The subsequent sections of the report furnish the details.

Proposed Cogeneration Schemes:

For Sheikhoo Sugar Mills Limited's Cogeneration plant two (2) alternate cycle parameters are discussed. The first two alternatives are based on 110 bar and 540 Deg.C steam parameters. The third and fourth alternatives are based on 67 bar and 485 Deg.C steam parameters. The last alternative is also based on 67 bar and 485 Deg.C alternative but without a regenerative feed water heater. This fifth alternative is only to make comparison of the other proposed alternatives with the fifth which is based on what is currently being operational in Pakistan. The attached Figures give the basic schemes for the proposed alternatives and the appropriate schemes may be referred to while reading the following descriptions.

Alternative I

This alternative considers two travelling grate multi fuel fired boilers, each of 210 TPH capacity. The boiler outlet steam parameters will be 110 bar (a) and 540 Deg.C. There will be two turbogenerators, each with a nominal capacity of 42 MW and with the turbine inlet steam parameters of 105 bar (a) and 535 Deg.C. The turbine and generator will be coupled through a gear box. The turbine will be designed with a controlled extraction port at 3 bar (a), for supplying the process steam and two uncontrolled extraction ports, one at 10 bar (a) and the other at 22 bar (a). There will be two stages of feed water heating to a final feed water temperature of 210 Deg.C. The total process steam and the regenerative heating steam will be drawn from the turbine extractions. The condenser of the turbine will be water cooled and shall be sized for condensing the steam flow during the off-season operation. The Cogeneration plant will be designed with all the auxiliary plants and systems like the fuel and ash handling system, Cooling water system, feed water system, Raw water and DM water system, Instrument air system, Distributed Control System, Electrical system and EHV transmission system etc., for its successful operation.

The total steam generation from the two boilers shall be 420 TPH and this will be fed to the two turbines. The steam extractions will be met by drawls from the Turbine. The estimated gross power generation from both the TG's, during the season operation, will be 82,644 kW. The total auxiliary power consumption of the Cogeneration plant will be 7,438 kW. With the power requirements of 17,342 kW for the sugar mill, the exportable power from the Cogeneration plant, during the season operation will be 57,864 kW.

During the off-season operation there will be no steam extraction to the sugar process. Each of the boilers will generate a steam quantity of 161 TPH. The gross power generation from each of the TG will be 42,000 kW. From both the TG's the gross power generation will be 84,000 kW. The auxiliary power consumption during the off-season operation is estimated to be 7,140 kW. With the power requirement of 1000 kW for the sugar mill, mainly for the sugar mill maintenance and for meeting the other general power requirements, the exportable power during the off-season operation will be 75,860 kW.

Attached Figs. I.1 and I.2 give the proposed Cogeneration schemes respectively for the season and off-season operations for the above discussed Alternative I.

With the in-house availability of 486,000 MT of bagasse, the season operation will consume 426,917.65 MT of bagasse, leaving 59,082.35 MT for the off-season operation. With the above discussed off-season operation and the above fuel quantity, the plant could operate for a period of 21 days on the saved bagasse. Assuming coal firing would be permitted and providing for 330 days of operation annually, the plant need to operate with coal for a period of 189 days. Assuming that the plant will use an imported coal with the HHV of 5625 kCals/kg, the annual coal consumption works out to 180,073 MT

The seasonal exportable electrical energy from the plant, with bagasse as the fuel, will be 149.98 Million Units. The off-season export with saved bagasse and coal respectively will be 34.41 Million Units and 309.69 Million Units. The total annual export will be 494.08 Million Units. With the usage of all the bagasse generated in-house, the fuel to be procured, annually, for the above operation will be 180,073 MT of imported coal. If the mill manages to get other bio-mass fuels, the above

coal requirement will come down depending on the availability of the bio-mass fuels. If the plant operates, both during the season and off-season only with the in-house generated bagasse and no coal operation is considered, then the annual exportable electrical energy will be 184.39 Million Units.

Alternative II

This alternative, similar to the Alternative I, is also based on the cycle parameters of 110 bar and 540 Deg.C. However, this alternative considers three travelling grate multi fuel fired boilers, each of 140 TPH capacity. The boiler outlet steam parameters will be 110 bar (a) and 540 Deg.C. There will be three turbogenerators, each with a nominal capacity of 28 MW and with the turbine inlet steam parameters of 105 bar (a) and 535 Deg.C. The turbine and generator will be coupled through a gear box. The turbine will be designed with a controlled extraction port at 3 bar (a), for supplying the process steam and two uncontrolled extraction ports, one at 10 bar (a) and the other at 22 bar (a). There will be two stages of feed water heating to a final feed water temperature of 210 Deg.C. The total process steam and the regenerative heating steam will be drawn from the extractions from all the three turbines. The condensers of the turbines will be water cooled and shall be sized for condensing the steam flow during the off-season operation. The Cogeneration plant will be designed with all the auxiliary plants and systems like the fuel and ash handling system, Cooling water system, feed water system, Raw water and DM water system, Instrument air system, Distributed Control System, Electrical system and EHV transmission system etc., for its successful operation.

The total steam generation from the three boilers shall be 420 TPH and this will be fed to the three turbines, each with 140 TPH. The steam extractions will be met by drawls from all the three Turbine. The estimated gross power generation from all the three TG's, during the season operation, will be 81,945 kW. The total auxiliary power consumption of the Cogeneration plant will be 7,375 kW. With the power requirements of 17,342 kW for the sugar mill, the exportable power from the Cogeneration plant, during the season operation will be 57,228 kW.

During the off-season operation there will be no steam extraction to the sugar process. Each of the three boilers will generate a steam quantity of 108.4 TPH. The

gross power generation from each of the TG will be 28,000 kW. From the three TG's the gross power generation will be 84,000 kW. The auxiliary power consumption during the off-season operation is estimated to be 7,140 kW. With the power requirement of 1000 kW for the sugar mill, mainly for the sugar mill maintenance and for meeting the other general power requirements, the exportable power during the off-season operation will be 75,860 kW.

Attached Figs. II.1 and II.2 give the proposed Cogeneration schemes respectively for the season and off-season operations for the above discussed Alternative II.

With the in-house availability of 486,000 MT of bagasse, the season operation will consume 426,917.65 MT of bagasse, leaving 59,082.35 MT for the off-season operation. With the above discussed off-season operation and the above fuel quantity, the plant could operate for a period of 21 days on the saved bagasse. Assuming coal firing would be permitted and providing for 330 days of operation annually, the plant need to operate with coal for a period of 189 days. Assuming that the plant will use an imported coal with the HHV of 5625 kCals/kg, the annual coal consumption works out to 181,862.53 MT.

The seasonal exportable electrical energy from the plant, with bagasse as the fuel, will be 148.33 Million Units. The off-season export with saved bagasse and coal respectively will be 34.41 Million Units and 309.69 Million Units. The total annual export will be 492.44 Million Units. With the usage of all the bagasse generated in-house, the fuel to be procured, annually, for the above operation will be 181,863 MT of imported coal. If the mill manages to get other bio-mass fuels, the above coal requirement will come down depending on the availability of the bio-mass fuels. If the plant operates, both during the season and off-season only with the in-house generated bagasse and no coal operation is considered, then the annual exportable electrical energy will be 182.75 Million Units.

Alternative III

This alternative is designed with the cycle parameters of 67 bar(a) and 485 Deg.C. This cycle parameters, even though inefficient compared to the 110 bar(a) and 540 Deg.C system, is studied mainly because of the fact that these parameters appear

to be the one presently used widely in Pakistan. However this alternative, as well as the Alternative IV, even though based on the 67 bar and 485 Deg.C cycle parameters are thermodynamic improvements over what is actually being used in Pakistan currently as these two alternative incorporate regenerative feed water heating, which improves the cycle efficiency. This alternative III, considers two travelling grate multi fuel fired boilers, each of 190 TPH capacity. The boiler outlet steam parameters will be 67 bar(a) and 485 Deg.C. There will be two turbogenerators, each with the nominal capacity of 34 MW and with the turbine inlet steam parameters of 64 bar (a) and 480 Deg.C. The turbine and generator will be coupled through a gear box. The turbine will be designed with a controlled extraction port at 3 bar (a) and one uncontrolled extraction port at 9 bar (a). There will be a single stage of feed water heating to a final feed water temperature of 170 Deg.C. The total process steam and regenerative heating steam will be drawn equally from the turbine extractions. The condenser of the turbine will be water cooled and shall be sized for off-season operation. The Cogeneration plant will be designed with all the auxiliary plants and systems like the fuel and ash handling system, Cooling water system, feed water system, Raw water and DM water system, Instrument air system, Distributed Control System, Electrical system and EHV transmission system etc., for its successful operation.

The total steam generation from both the boilers shall be 380 TPH and this will be fed to both the turbines. The total steam extractions will be met by drawl from the Turbines. The estimated gross power generation from each of the TG, during the season operation, will be 33,465 kW and total generation 66,930 kW. The total auxiliary power consumption of the Cogeneration plant will be 5689 kW. With the power requirements of 17,342 kW for the sugar mill, the exportable power from the Cogeneration plant, during the season operation will be 43,899 kW.

During the off-season operation there will be no steam extraction to sugar process. Each of the boiler will generate steam quantity of 141 TPH. The gross power generation from each of the TG will be 34,000 kW. Power generation from both the TG's will be 68,000 kW. The auxiliary power consumption during the off-season operation is estimated to be 5,780 kW. With the power requirement of 1000 kW for the sugar mill, the exportable power during the off-season operation will be 61,220 kW.

Attached Figs. III.1 and III.2 give the proposed Cogeneration schemes respectively for the season and off-season operation for the Alternative III.

With the in-house availability of 486,000 MT of bagasse, the season operation will consume 405,333.33 MT of bagasse, leaving 80,666.67 MT for the off-season operation. With the above discussed off-season operation and the above fuel quantity, the plant could operate for a period of 32 days on the saved bagasse. Assuming that the coal firing would be permitted and providing for 330 days of operation annually, the plant need to operate with coal for a period of 178 days. Assuming that the plant will use an imported coal with the HHV of 5625 kCals/kg, the annual coal consumption works out to 148,525 MT.

The seasonal exportable electrical energy from the plant with bagasse firing, will be 113.79 Million Units. The off-season export with saved bagasse and coal respectively will be 42.32 Million Units and 235.38 Million Units. The total annual export will be 391.48 Million Units. With the usage of all the bagasse generated in-house, the fuel to be procured, annually, for the above operation will be 148,525 MT of imported coal. If the mill manages to get other bio-mass fuels, the above coal requirement will come down depending on the availability of the bio-mass fuels. If the plant operates, both during the season and off-season only with the in house generated bagasse and no coal operation is considered, then the annual exportable electrical energy will be 156.10 Million Units.

Alternative IV

This alternative, similar to alternative III, is also designed with the cycle parameters of 67 bar(a) and 485 Deg.C. This alternative IV, considers three travelling grate multi fuel fired boilers, each of 130 TPH capacity. The boiler outlet steam parameters will be 67 bar(a) and 485 Deg.C. There will be three turbogenerators, each with the nominal capacity of 23 MW and with the turbine inlet steam parameters of 64 bar (a) and 480 Deg.C. The turbine and generator will be coupled through a gear box. The turbine will be designed with a controlled extraction port at 3 bar (a) and one uncontrolled extraction port at 9 bar (a). There will be a single stage of feed water heating to a final feed water temperature of

170 Deg.C. The total process steam and regenerative heating steam will be drawn equally from all the three turbine extractions. The condenser of the turbine will be water cooled and shall be sized for off-season operation. The Cogeneration plant will be designed with all the auxiliary plants and systems like the fuel and ash handling system, Cooling water system, feed water system, Raw water and DM water system, Instrument air system, Distributed Control System, Electrical system and EHV transmission system etc., for its successful operation.

The total steam generation from both the boilers shall be 390 TPH and this will be fed equally to all the turbines. The total steam extractions will be met by drawl from all the three Turbines. The estimated gross power generation from each of the TG, during the season operation, will be 22,846 kW and total generation 68,538 kW. The total auxiliary power consumption of the Cogeneration plant will be 5826 kW. With the power requirements of 17,342 kW for the sugar mill, the exportable power from the Cogeneration plant, during the season operation will be 45370 kW.

During the off-season operation there will be no steam extraction to sugar process. Each of the boiler will generate steam quantity of 99.08 TPH. The gross power generation from each of the TG will be 23,000 kW. Power generation from all the three TG's will be 69,000 kW. The auxiliary power consumption during the off-season operation is estimated to be 5,865 kW. With the power requirement of 1000 kW for the sugar mill, the exportable power during the off-season operation will be 62,135 kW.

Attached Figs. IV.1 and IV.2 give the proposed Cogeneration schemes respectively for the season and off-season operation for the Alternative IV.

With the in-house availability of 486,000 MT of bagasse, the season operation will consume 416,000 MT of bagasse, leaving 70,000 MT for the off-season operation. With the above discussed off-season operation and the above fuel quantity, the plant could operate for a period of 26 days on the saved bagasse. Assuming that the coal firing would be permitted and providing for 330 days of operation annually, the plant need to operate with coal for a period of 184 days. Assuming that the plant will use an imported coal with the HHV of 5625 kCals/kg, the annual coal consumption works out to 161,829 MT.

The seasonal exportable electrical energy from the plant with bagasse firing, will be 117.60 Million Units. The off-season export with saved bagasse and coal respectively will be 34.9 Million Units and 246.95 Million Units. The total annual export will be 399.44 Million Units. With the usage of all the bagasse generated in-house, the fuel to be procured, annually, for the above operation will be 161,829 MT of imported coal. If the mill manages to get other bio-mass fuels, the above coal requirement will come down depending on the availability of the bio-mass fuels. If the plant operates, both during the season and off-season only with the in house generated bagasse and no coal operation is considered, then the annual exportable electrical energy will be 152.49 Million Units.

Alternative V

This alternative is included to show the difference between what has already been done in Pakistan and the new schemes proposed. This is similar to alternative IV, but for the regenerative feed water heating and is also designed with the cycle parameters of 67 bar(a) and 485 Deg.C. This alternative V, considers three travelling grate multi fuel fired boilers, each of 130 TPH capacity. The boiler outlet steam parameters will be 67 bar(a) and 485 Deg.C. There will be three turbogenerators, each with the nominal capacity of 24 MW and with the turbine inlet steam parameters of 64 bar (a) and 480 Deg.C. The turbine and generator will be coupled through a gear box. The turbine will be designed with a controlled extraction port at 3 bar (a) and one uncontrolled extraction port at 9 bar (a). There will be no feed water heating downstream of the deaerator and the feed water temperature entering the boiler will be 130 Deg.C. The total process steam and deaerator heating steam will be drawn equally from all the three turbine extractions. The condenser of the turbine will be water cooled and shall be sized for off-season operation. The Cogeneration plant will be designed with all the auxiliary plants and systems like the fuel and ash handling system, Cooling water system, feed water system, Raw water and DM water system, Instrument air system, Distributed Control System, Electrical system and EHV transmission system etc., for its successful operation.

The total steam generation from both the boilers shall be 390 TPH and this will be fed equally to all the turbines. The total steam extractions will be met by drawl from all the three Turbines. The estimated gross power generation from each of the TG, during the season operation, will be 23,941 kW and total generation 71,823 kW. The total auxiliary power consumption of the Cogeneration plant will be 6,105 kW. With the power requirements of 17,342 kW for the sugar mill, the exportable power from the Cogeneration plant, during the season operation will be 48,376 kW.

During the off-season operation there will be no steam extraction to sugar process. Each of the boiler will generate steam quantity of 99.14 TPH. The gross power generation from each of the TG will be 24,000 kW. Power generation from all the three TG's will be 72,000 kW. The auxiliary power consumption during the off-season operation is estimated to be 6,120 kW. With the power requirement of 1000 kW for the sugar mill, the exportable power during the off-season operation will be 64,880 kW.

Attached Figs. V.1 and V.2 give the proposed Cogeneration schemes respectively for the season and off-season operation for the Alternative V.

With the in-house availability of 486,000 MT of bagasse, the season operation will consume 449,280 MT of bagasse, leaving 36,720 MT for the off-season operation. With the above discussed off-season operation and the above fuel quantity, the plant could operate for a period of 13 days on the saved bagasse. Assuming that the coal firing would be permitted and providing for 330 days of operation annually, the plant need to operate with coal for a period of 197 days. Assuming that the plant will use an imported coal with the HHV of 5625 kCals/kg, the annual coal consumption works out to 173.367 MT.

The seasonal exportable electrical energy from the plant with bagasse firing, will be 125.39 Million Units. The off-season export with saved bagasse and coal respectively will be 18.22 Million Units and 276.08 Million Units. The total annual export will be 419.69 Million Units. With the usage of all the bagasse generated in-house, the fuel to be procured, annually, for the above operation will be 173,367 MT of imported coal. If the mill manages to get other bio-mass fuels, the above coal requirement will come down depending on the availability of the bio-mass fuels.

If the plant operates, both during the season and off-season only with the in house generated bagasse and no coal operation is considered, then the annual exportable electrical energy will be 143.61 Million Units.

COMMENTARY ON THE ALTERNATIVES:

All the above alternatives, proposed in this concept report, meet with the complete process steam and power requirements of the sugar mill, but however the energy export under the various alternatives differ.

Considering the difficult power situation in the country, Pakistan is planning to exploit this, easily available and exploitable, source of additional power generation to the maximum extent. Under such circumstances, it is better to adopt the highest possible and proven steam parameters for the Cogeneration plant so that the maximum benefits are derived with the available bagasse. The Alternatives I & II presented in this concept note are based on the boiler outlet steam parameters of 110 bar(a) and 540 Deg.C. Many plants designed to these parameters are in operation in sugar mill environments. The operations have shown that there are no technical issues related to the operation or in the achievement of the designed efficiencies. The plants designed with these parameters have shown that they can produce at least about 8% and 18% more power respectively than the earlier plants designed with the parameters of 87 bar(a) and 515 Deg.C and 67 bar(a) and 485 Deg.C., for the same quantum of fuel used. In specific cases the difference could be much higher. With this background it is advisable to go in for the most efficient of the available technologies and hence the selection of the above said parameters. Even though a few projects with the boiler outlet steam parameters of 125 bar (a) and 545 Deg.C are under implementation, the present operating experience is only with two plants and hence it is not recommended for this project. A 62.4 MW bagasse based Cogeneration designed with the steam parameters of 110 bar (a) and 540 Deg.C is already under implementation in Pakistan and this plant will likely go on stream by October 2015.

The alternatives III and IV proposed are based on 67 bar(a) and 485 Deg.C, parameters ond with a high pressure feed water to heat the feed water to a final

temperature of 170 Deg.C. There are dozens of plants in operation with these parameters and the oldest plant should be operating for a period not less than 25 years. These parameters were the earliest used in bagasse based Cogeneration plants and a lot of developments had happened in the steam parameters and other design parameters in the bagasse based Cogeneration industry.

The Alternative V presented in this report, as explained elsewhere, is the basic cycle with the 67 bar(a) and 485 Deg.C steam parameters. This alternative does not use regenerative feed water heating and the feed water temperature entering the boiler will be 130 Deg.C. This was the cycle which had so far been used in Pakistan for a few of the Cogeneration projects commissioned and operating. Even the job what Avant-Garde has done in Pakistan is similar to what is presented in this Alternative , and the reasons why it had been done that way is beyond the realm of this report. This alternative is presented only for the purpose of comparison with the other proposed alternatives.

In terms of efficiencies the Alternatives I and II should be identical, as they use the same cycle parameters. However it is seen that there is a difference of about 1.65 Million Units in the exportable energy, with the Alternative I having the advantage, just with the in-house generated bagasse This is mainly because of the number of units and the unit sizes. As the unit size goes down it affects the efficiency. Same is true with the alternatives III and IV. Even though both are based on the 67 bar(a) and 485 Deg.C stem parameters, the Alternative with two units is efficient compared to the alternative with three units. Opting for the Alternative with two units or three units depends on how SSML wants to proceed with the implementation.

The advantage of not going for Alternative V , even comparing with the Alternative IV, which is the least efficient of other four alternatives, is about 8.89 Million Units of export, about 6.2%, just with the in-house bagasse. With every other thing remaining same between Alternatives IV and V, it may be seen how the addition of a single stage high pressure feed water heater improves the plant cycle efficiency.

Table I gives the comparison of the salient technical details of all the Alternatives. This Table gives the important technical details for each of the Alternatives, which could help SSML in taking a decision regarding the final configuration of their Cogeneration plant. It is assumed that the Cogeneration plant will operate for a period of 330 days in a year. It is understood that as of now there is no policy enunciated by NEPRA for coal based smaller power plants. Hence, the Table gives the scenarios in terms of operation with both in-house bagasse and coal and only with in-house bagasse. The Table gives annual the exportable energy using only in-house bagasse and also the total annual energy export in case the plant operates with both bagasse and coal. The quantum of coal usage per annum also is given. In case coal is not proposed to be used and if SSML can find, additional bagasse from nearby sugar mills or any compatible bio-mass fuel for the operation the number of days of operation in the off-season could be extended. The projections in the Table do not consider any bought out bagasse or any other bio-mass fuel for the operation of the plant. These information provided should help SSML to decide on the viability of the Cogeneration plant only with in-house bagasse.

It may be seen from the Table that even looking at only the in-house bagasse usage, the exportable energy from the 110 bar(a) and 540 Deg.C systems is higher than that could be got from the 67 bar(a) and 485 Deg.C system. Comparing the Alternatives I and III, both with two units configuration, for the in-house bagasse usage the annual exportable energy in Alternative I is 28.29 Million Units more than that with the Alternative III. This is an increase of about 18.12% with the 110 bar(a) and 540 deg.C cycle system over the 67 Bar(a) and 485 Deg.C cycle system.

The total process steam requirements will be drawn from the turbine extractions. Under normal circumstances, all the turbines (whether it is two or three) will equally share the extraction steam supply. If for some reason, the extraction from one of the turbine is to be reduced the same could be done without any difficulty. All the condensate of the extracted steam at 2.5 bar(a) shall be returned to the Cogeneration plant from the evaporator station in the sugar mill. There shall be no flash steam interconnections to the other evaporator bodies from this steam condensate, to eliminate any chance of contamination. The make up for the Cogeneration plant shall be only demineralised water and no vapour condensate shall be used as make up. With the process steam to the sugar mill operation coming from turbine controlled extractions, the evaporator station in the sugar house will

be supplied with a steady pressure process steam. The availability of steady steam pressure at the process house will itself ensure a few percentage points reduction in the process steam consumption of the sugar plant.

MAJOR EQUIPMENT AND SYSTEMS INVOLVED

The following gives the major equipment and systems involved in the Cogeneration plant. There could be other equipment and systems for the interconnection of the Cogeneration plant and the sugar mill.

* Steam generator and Auxiliaries
* Turbogenerator and Auxiliaries.
* Fuel & grate bottom ash Handling system.
* Cooling Tower
* Water treatment plant and other associated systems
* Air compressor and dryer
* Air conditioning & ventilation system
* Centrifugal Pumps and Drives.
* Dense Phase ash handling system
* EOT crane
* Piping and appurtenances.
* Electrical distribution, MCC, PCC, cables, lighting, Transformers, switchyard
* DCS and Balance Of Plant (BOP) Instrumentation
* Fire Fighting System
* Civil works

The steam generator (boiler) and the turbogenerator are the two critical equipment making up to 60% of the cost of the complete Cogeneration plant. As the boiler is the most critical out of two equipment for the operation of both the Cogeneration plant and the sugar plant, a safe design approach is recommended. As it is expected that the boilers could be sourced locally or from China or India, it is better to go for proven capacities what these potential manufacturers can make. The points related to the type and capacity of the boiler had been discussed earlier under the topic on "Type and Size of the Boiler" in the section on the "General Design Philosophy". As boilers with the same steam parameters and capacities

around the proposed capacities are in operation, there is no risk in going with the sizes given in the various Alternatives.

OPERATION OF THE SUGAR MILL AT A LOWER CRUSHING

The suggested plant configurations can operate with lesser crushing also, on a continuous basis, but with a lower permissible limit on the boiler MCR loads. As the fuel availability comes down with lower crushing it may become necessary to reduce the power generation. As the Turbines are extraction condensing type and some minimum flow of steam is required for the condensers for the system to operate without any problem, it is essential that such operations are discussed before the plant is designed. With lower crushing it may also be difficult to get enough bagasse to operate even for a few days in the off-season.

IMPLEMENTATION OF THE COGENERATION PLANT

The complete Cogeneration plant, irrespective of the Alternative could be implemented within a period of Eighteen to Twenty months from the date of purchase order to the EPC Contractor. The boiler makers in Pakistan do not experience of designing 110 Bar(a) boiler of the discussed size, but could design and manufacture the boilers of 67 bar (a) pressure. Even with the indigenous manufacturer, the time schedule discussed above could not be reduced much as a lot of raw materials and bought out boiler components would have to be imported. If SSML decide to implement the project in phases, it could be done as all the alternatives proposed are with two or more units. The number of phases in which SSML plans to implement the project as well as the operation of the commissioned units in synchronization with the existing low pressure boilers should be studied in detail. Operating the high pressure Cogeneration plant in synchronization with the low pressure boilers is not difficult but the operating personnel should adequate care to know the difficulties involved in such operations and how mal-operation could affect the operation of the high pressure Cogeneration plant. Even if SSML decide to implement the project in phases, there are a few equipment which are to be designed for the ultimate capacity, even under the first phase itself. The details should be discussed and agreed before the finalization of the project implementation program.

LOCATION OF THE PLANT

For the Cogeneration plant, specifically when locating it in an operating sugar mill, laying out the Cogeneration plant is very important. Considering the fact that the Cogeneration plant construction will take more than 12 months and in the meantime the sugar mill will have to go through one or two seasons of crushing, the location chosen for the Cogeneration plant should be such that the construction activities shall not pose any hindrance to the sugar mill operations. Also it is important to locate the Cogeneration plant as close to the sugar mill as possible to minimize the cost of interconnections for the bagasse, power, the process steam and the condensate. It is also important that the boiler and TG are kept closer to reduce the cost of the high pressure and high temperature piping interconnecting them. Also a higher pressure drop in the piping reduces the plant efficiency. The cooling towers should be located away from bagasse and the location should be appropriate from the point of the predominant wind direction at the site. The switch yard shall be located, away from the cooling tower and bagasse and with the ease of grid interfacing in mind.

BUDGETARY PROJECT COST

The cost of the Cogeneration projects had been increasing due to the escalation in the price of all the input materials. However, in the last two years because of the cooling of the world commodity prices there is no appreciable increase in the cost of the project in the last two years. Almost 90% of the materials used in the Cogeneration plant is steel, in one form or the other, and hence with the rise in steel prices the Cogeneration project costs will also rise.

It is assumed that the proposed Cogeneration project of Sheikhoo Sugar Mills Limited will be implemented through the 'Engineering Procurement and Construction' (EPC) route. The project EPC budgetary cost for the various alternatives discussed hereunder had been worked out based on the prevailing costs of a few of the projects under execution in Pakistan. The estimated EPC costs for the Alternatives I, II, III, IV and V respectively are US$ 92.5, US$ 96.5, US$ 71, US$ 76 and US$ 78.5 Million. These costs include the costs of coal handling and feeding system to the boiler. The costs of the coal handling and feeding systems and reduction in

the boiler cost for not designing for coal firing for all the alternatives, will be respectively US$ 2.8, US$ 2.95, US$ 2.6, US$ 2.75 and US$ 2.75 Million. Without the coal handling and feeding system the EPC costs for the Alternatives will respectively be US$ 89.7, US$ 93.55, US$ 68.4, US$ 73.25 and US$ 75.75 Million.

The estimated costs discussed above are the EPC costs and the total project cost is to be calculated considering the Interest during construction and other preliminary and pre-operative costs.

CONCLUSION

Bagasse based Cogeneration technology had been successfully implemented in many countries around the world. With many benefits, as discussed earlier in this report, these short gestation projects offer a convenient way to augment the grid capacity. For a fast developing economy like Pakistan, these projects with the expected capacity addition of 2500 MW to the total installed capacity of around 20,000 MW will make immense difference.

All the Alternatives proposed are technically feasible and adoptable. Similar configurations are already operating in sugar mills. The most suitable of the Alternatives could be selected considering economics, flexibility of operation, quantum of bought out fuels required etc. However with the overwhelming preference for the 110 bar(a) system, based on the reasons of better efficiency, it may be advisable to choose an Alternative, with 110 bar(a) and 540 Deg.C as the operating steam parameters.

SHEIKHOO SUGAR MILLS LIMITED

CONCEPT PAPER ON BAGASSE BASED COGENERATION PROJECT - CRUSHING CAPACITY 16000 TCD

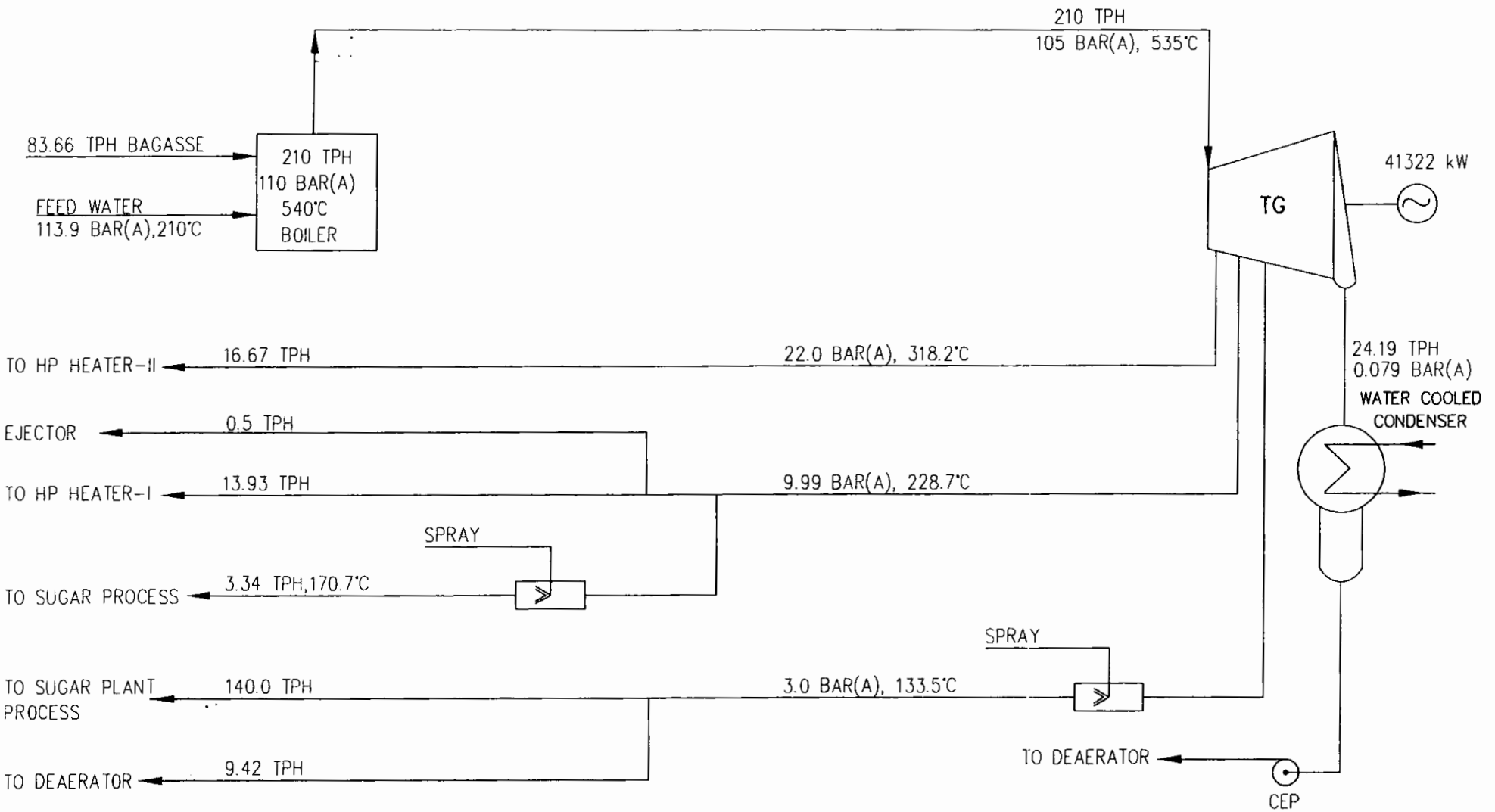
TABLE - I

S.NO	DESCRIPTION	Alt_I	Alt_I	ALT_III	ALT_IV	ALT_V
I	Sugar Plant Operating Data					
1	Crushing Capacity (TCH)	667.00	667.00	667.00	667.00	667.00
2	Bagasse Generoted (TPH @ 29.55% on Cane)	197.10	197.10	197.10	197.10	197.10
3	Bagasse for Bagacilla & Losses (TPH)	9.60	9.60	9.60	9.60	9.60
4	Bagasse available for usage in Cogeneration (TPH)	187.50	187.50	187.50	187.50	187.50
5	2.5 bar (a) steam requirement @ 42% (TPH)	280.14	280.14	280.14	280.14	280.14
6	Recoverable condensate from 2.5 bar(a) steam to process (TPH)	271.74	271.74	271.74	271.74	271.74
7	8 bar (a) steam required for sugar Process @ 1% on Cane (TPH)	6.67	6.67	6.67	6.67	6.67
8	Condensate Return from 8 Bar Steam supply (TPH)	0.00	0.00	1.00	1.00	1.00
9	Electrical Power requirement of the sugar mill (kw)	17342.00	17342.00	17342.00	17342.00	17342.00
10	Average Number of Days of Season Operation	120	120	120	120	120
11	Annual Bagasse Generation considering 90% plant Capacity Utilization for Sugar Mill (MT)	486000.00	486000.00	486000.00	486000.00	486000.00
II	High Pressure Cogeneration System					
1	Boiler Outlet Steam Pressure (bar(a))	110.00	110.00	67.00	67.00	67.00
2	Boiler Outlet Steam Temperature (Deg.C)	540.00	540.00	485.00	485.00	485.00

S.NO	DESCRIPTION	Alt_I	Alt_I	ALT_III	ALT_IV	ALT_V
3	No. of Boilers	2	3	2	3	3
4	Total Boiler Steam Generation capacity (TPH)	420.00	420.00	380.00	390.00	390.00
5	Individual Boiler Capacities (TPH/TPH)	2x210	3x140	2x190	3x130	3x130
6	Actual HP Steam Generation in Seaosn (TPH)	420.00	420.00	380.00	390.00	390.00
7	Bagasse consumption (TPH)	164.71	164.71	156.38	160.49	173.33
8	Extractian Condensing TG Capacity (MW)	42.00	28.00	34.00	23.00	24.00
9	Number of Extraction Condensing TGs	2	3	2	3	3
10	Backpressure TG Capacity (MW)	NA	NA	NA	NA	NA
11	Number of Backpressure TGs	NA	NA	NA	NA	NA
12	Generation in Extraction Condensing TGs in Season (kW)	41322	27315	33465	22846	23941
13	Generation in Backpressure TG in Season (kW)	NA	NA	NA	NA	NA
14	Total Grass Power Generation in Season	82644	81945	66930	68538	71823
15	2.5 bar(a) Process steam supply from Cogen Plant (TPH)	280.14	280.14	280.14	280.14	280.14
16	8 bar(a) steam supply to process (TPH	6.67	6.67	6.67	6.67	6.67
17	HP Cagen Auxiliary Power Consumptian (kW)	7438.00	7375.00	5689.00	5826.00	6105.00

S.NO	DESCRIPTION	Alt_I	Alt_I	ALT_III	ALT_IV	ALT_V
III	**Power Generation, Auxiliary Consumption & Export In Season**					
1	Generation in the HP system (kW)	82644.00	81945.00	66930.00	68538.00	71823.00
2	Generation in the LP System (kW)	NA	NA	NA	NA	NA
3	Total Power Generation in the Mill complex (kW)	82644.00	81945.00	66930.00	68538.00	71823.00
4	Auxiliary power Consumption af the HP System (kW)	7438.00	7375.00	5689.00	5826.00	6105.00
5	Auxiliary Power Cansumption of the LP System (kW)	NA	NA	NA	NA	NA
6	Power Cansumption of the Sugar Mill (kW)	17342.00	17342.00	17342.00	17342.00	17342.00
7	Export from the Mill (kW)	57864.00	57228.00	43899.00	45370.00	48376.00
IV	**Bagasse Balances**					
1	Bagasse from Crushing Operatians (MT)	486000.00	486000.00	486000.00	486000.00	486000.00
2	Bgasse Consumption in the HP system (MT)	426917.65	426917.65	405333.33	416000.00	449280.00
3	Bagasse Consumption in the LP System (MT)	NA	NA	NA	NA	NA
4	Tatal Bagasse Consumption in Season (MT)	426917.65	426917.65	405333.33	416000.00	449280.00
5	Saving in bagasse For Off-Season Operation (TPH)	59082.35	59082.35	80666.67	70000.00	36720.00
V	**Off-Season Operatian (Operation with saved bagasse and coal)**					
1	Number of Boilers in Operatian	2	3	2	3	3
2	Number of TGs in Operation	2	3	2	3	3

S.NO	DESCRIPTION	Alt_I	Alt_I	ALT_III	ALT_IV	ALT_V
3	Total Steam generation (TPH)	322.00	325.20	282.00	297.24	297.42
4	Bagasse consumption (TPH)	127.78	129.05	117.50	123.85	132.19
5	Number of days of operation with saved bagasse	21.00	21.00	32.00	26.00	13.00
6	Coal consumption (HHV of 5625 kCals/kg) (TPH)	44.11	44.55	38.63	40.72	40.74
7	Off-Season operation days with coal (Considering a total of 330 days per annum)	189.00	189.00	178.00	184.00	197.00
8	**Coal requirement for aff-season operation (MT/Annum)**	**180072.99**	**181862.53**	**148525.15**	**161828.86**	**173367.34**
9	Gross power generation (kW)	84000.00	84000.00	68000.00	69000.00	72000.00
10	Power consumption in sugar plant (kW)	1000.00	1000.00	1000.00	1000.00	1000.00
11	Auxiliary power consumptian (kW)	7140.00	7140.00	5780.00	5865.00	6120.00
12	Exportable Power in Off-season (kW)	75860.00	75860.00	61220.00	62135.00	64880.00
VII	**Annual Export**					
1	Season Electrical Energy Export (Million Units) Considering 90% plant Capacity factor	149.98	148.33	113.79	117.60	125.39
2	Off_season Electrical Energy Export (million Units)					
	With Bagasse as the Fuel (Million Units)	34.41	34.41	42.32	34.90	18.22
	With Coal (Million Units)	309.69	309.69	235.38	246.95	276.08
3	Total Annual Electrical Energy Export (Million Units)	494.08	492.44	391.48	399.44	419.69
4	Percentage of Energy Exparted with Bio-mass fuel over the total annual Export (%)	37.32	37.11	39.87	38.18	34.22
5	Total Export Only from in-house Bagasse (Million Units)	184.39	182.75	156.10	152.49	143.61



NO.OF UNITS - 2

ENGINEERING CONTRACTOR:

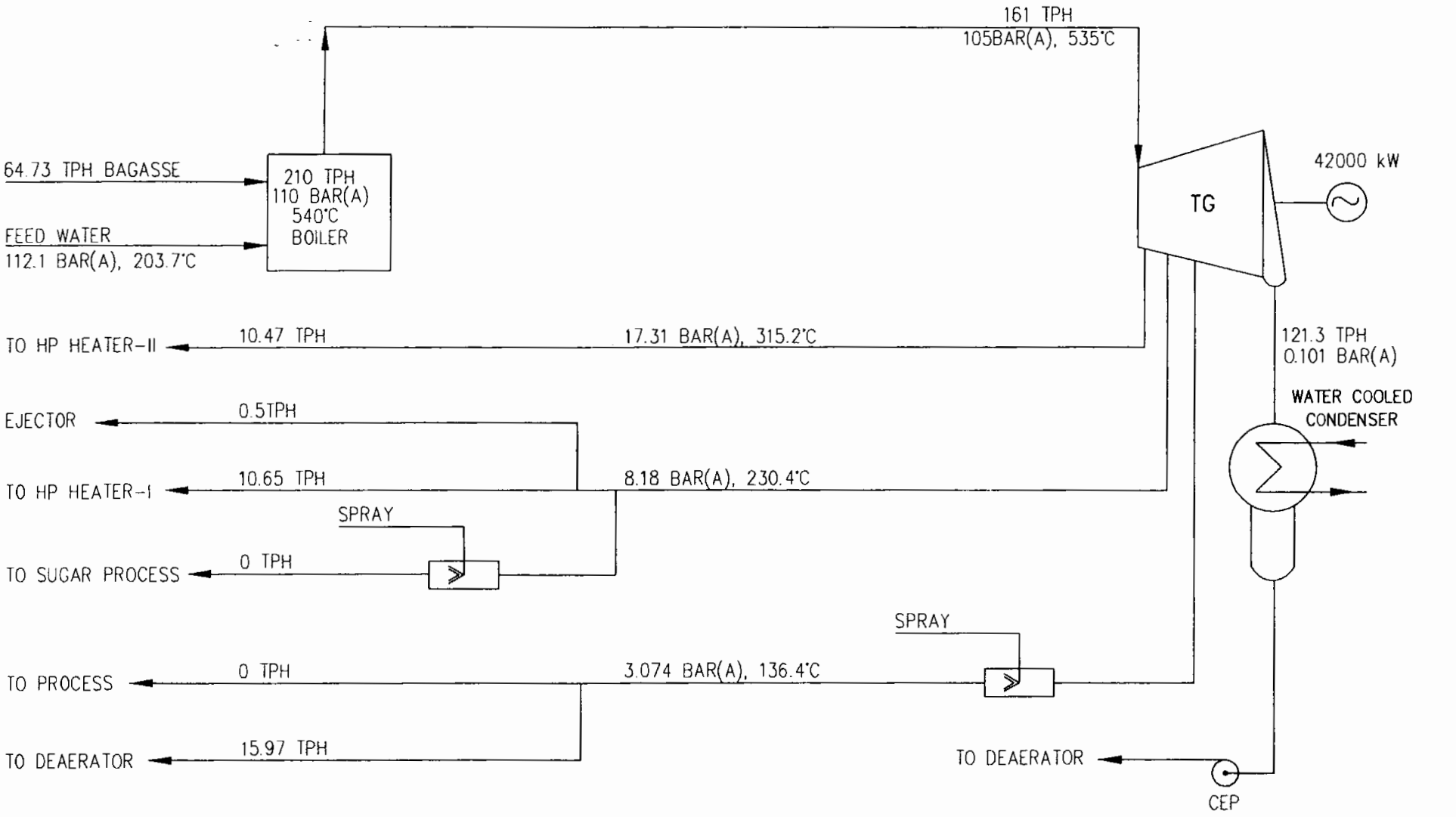
AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
TITLE	COGENERATION SCHEME - SEASON OPERATION (ALT-I)

	NAME	SIGN
DRN	S.PRABHU	
CHD	S.SIVAKUMAR	
APPD	S.BALASUBRAMANIAN	

DRAWING NO.

FIG.I.1



NO.OF UNITS – 2

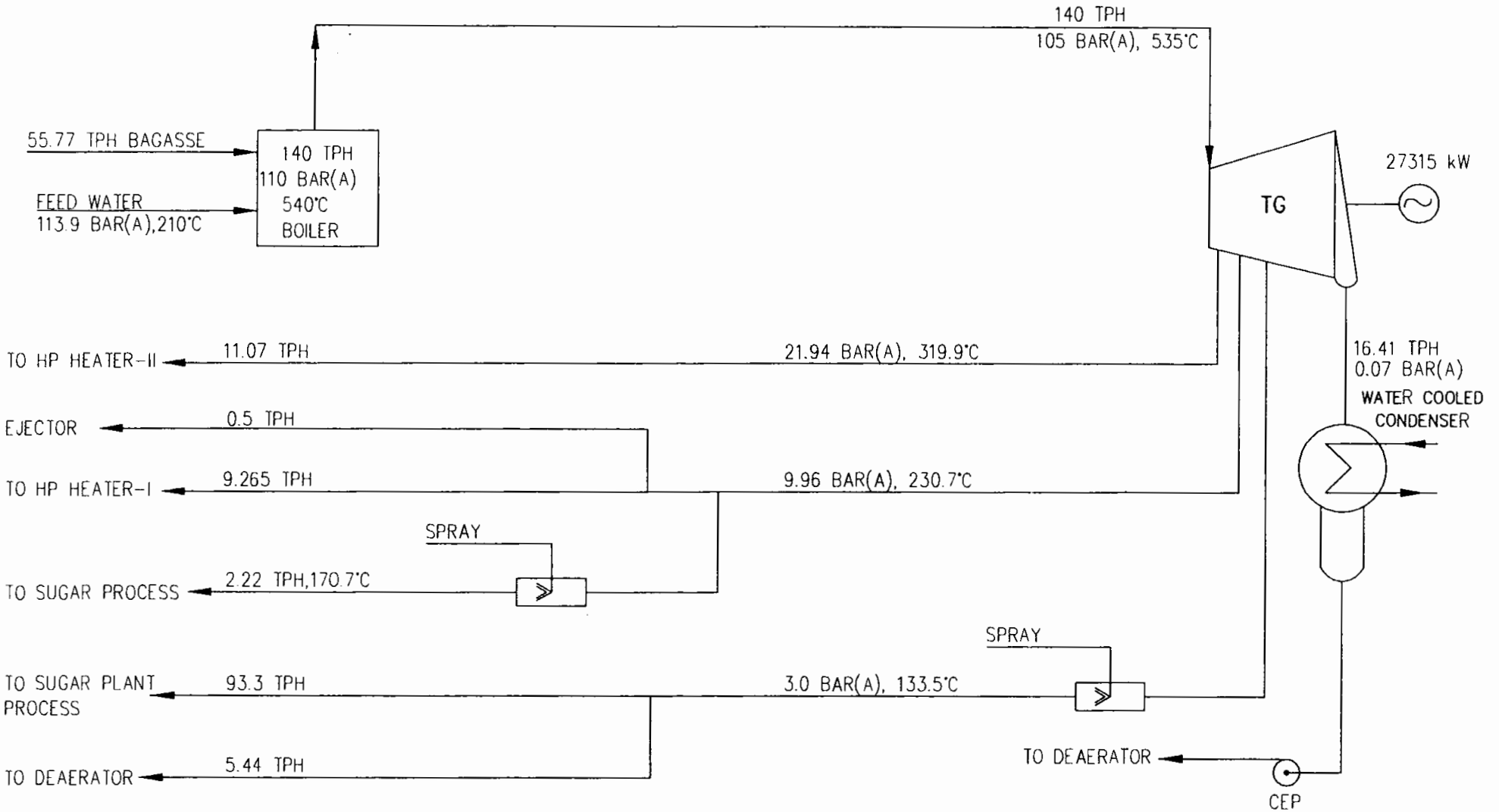
ENGINEERING CONTRACTOR:

AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
	COGENERATION SCHEME – OFF SEASON OPERATION (ALT-I)

	NAME	SIGN
DRN	S.PRABHU	
CHD	S.SIVAKUMAR	
APPD	S.BALASUBRAMANIAN	

DRAWING NO. FIG 1.2



NO.OF UNITS - 3

ENGINEERING CONTRACTOR:

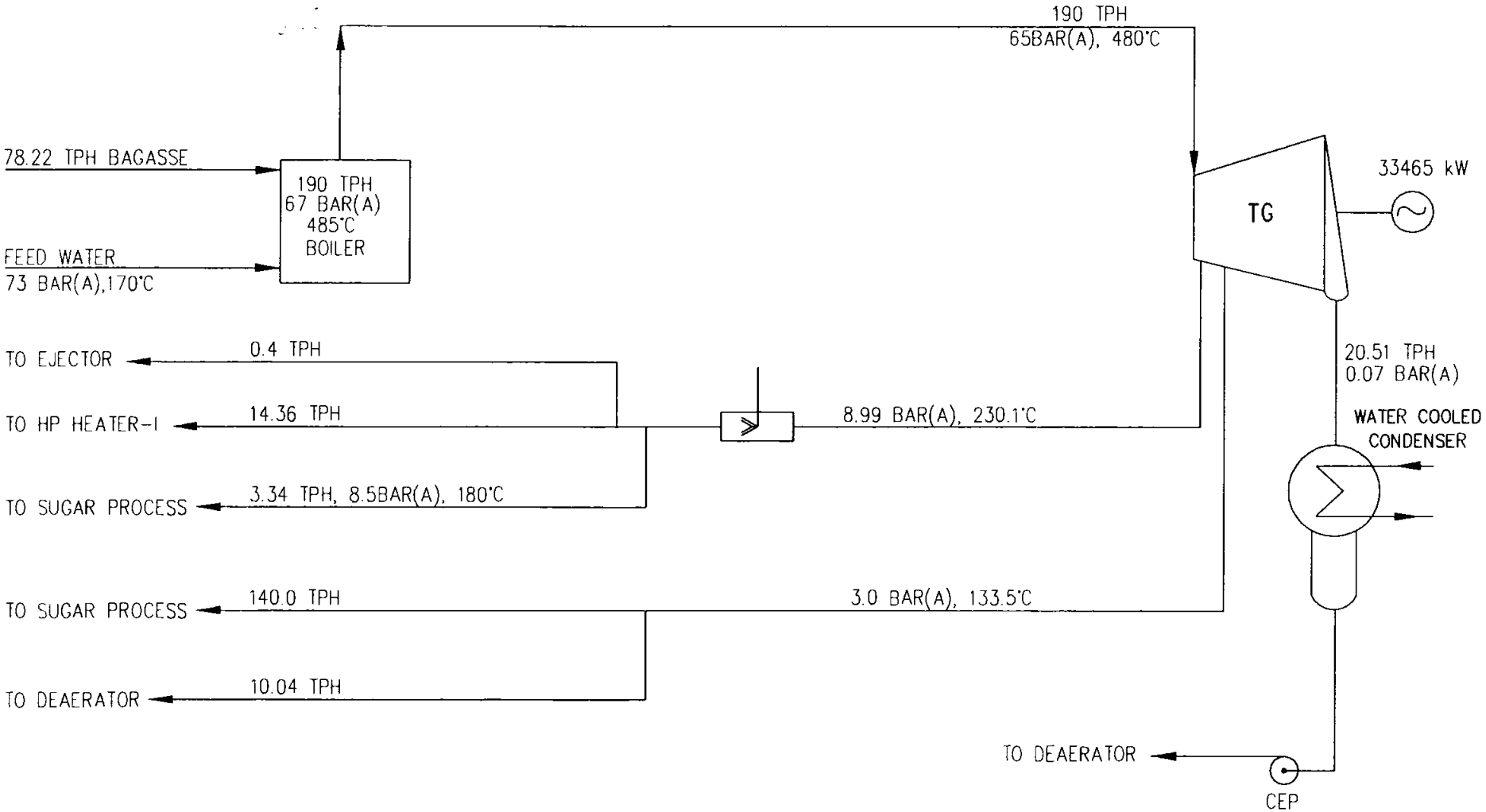
AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
	COGENERATION SCHEME – SEASON OPERATION (ALT-II)

	NAME	SIGN
DRN	S.PRABHU	
CHD	S.SIVAKUMAR	
APPD	S.BALASUBRAMANIAN	

DRAWING NO.

FIG II.1



NO.OF UNITS – 2

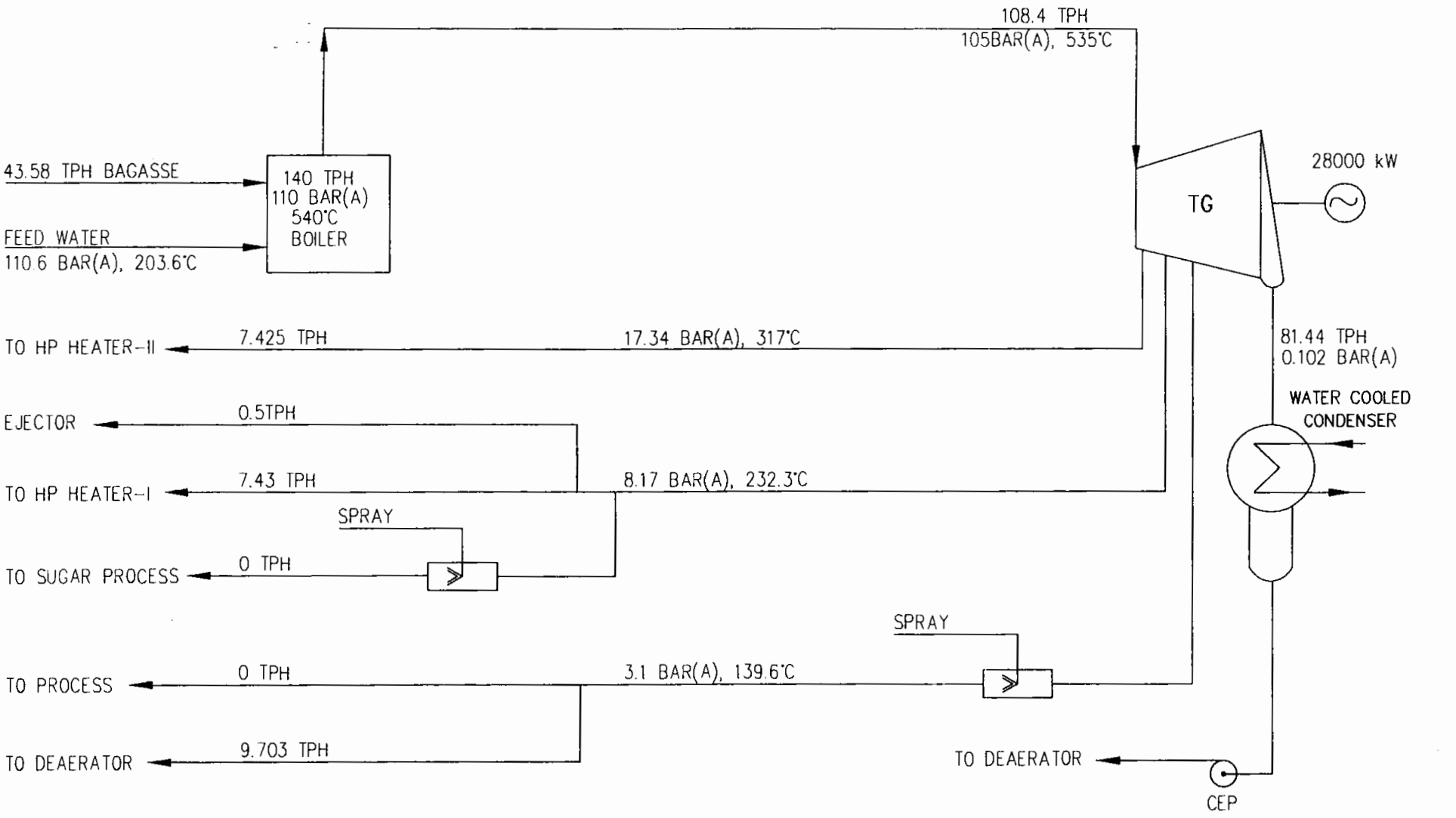
ENGINEERING CONTRACTOR:

AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE

	NAME	SIGN
DRN	S.PRABHU	
CHD	S.SIVAKUMAR	
APPD	S.BALASUBRAMANIAN	

DRAWING NO.



NO.OF UNITS - 3

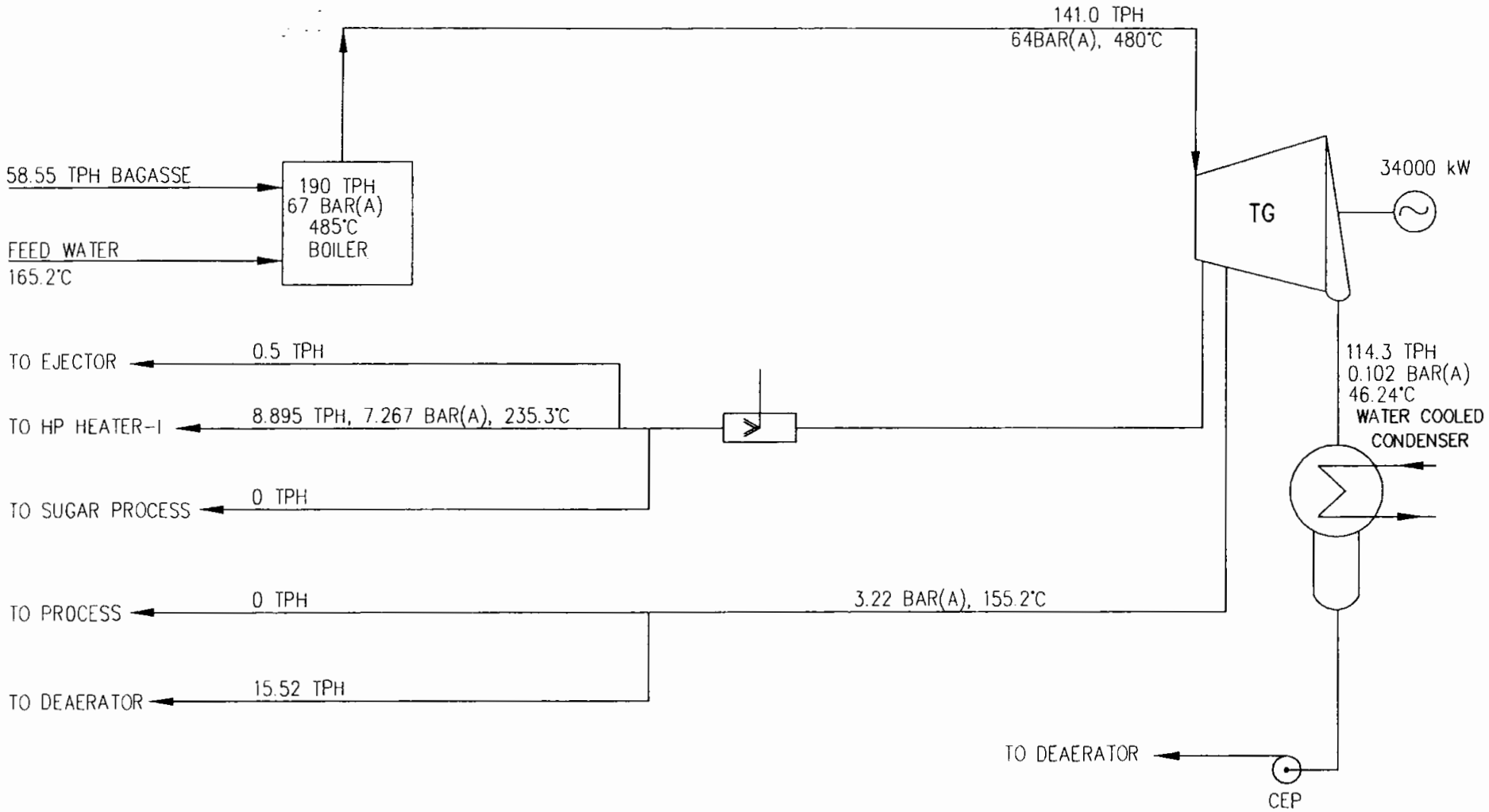
ENGINEERING CONTRACTOR:

AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
	COGENERATION SCHEME - OFF SEASON OPERATION (ALT-II)

	NAME	SIGN
DRN	S.PRABHU	
CHD	S.SIVAKUMAR	
APPD	S.BALASUBRAMANIAN	

DRAWING NO. FIG II 2



NO.OF UNITS - 2

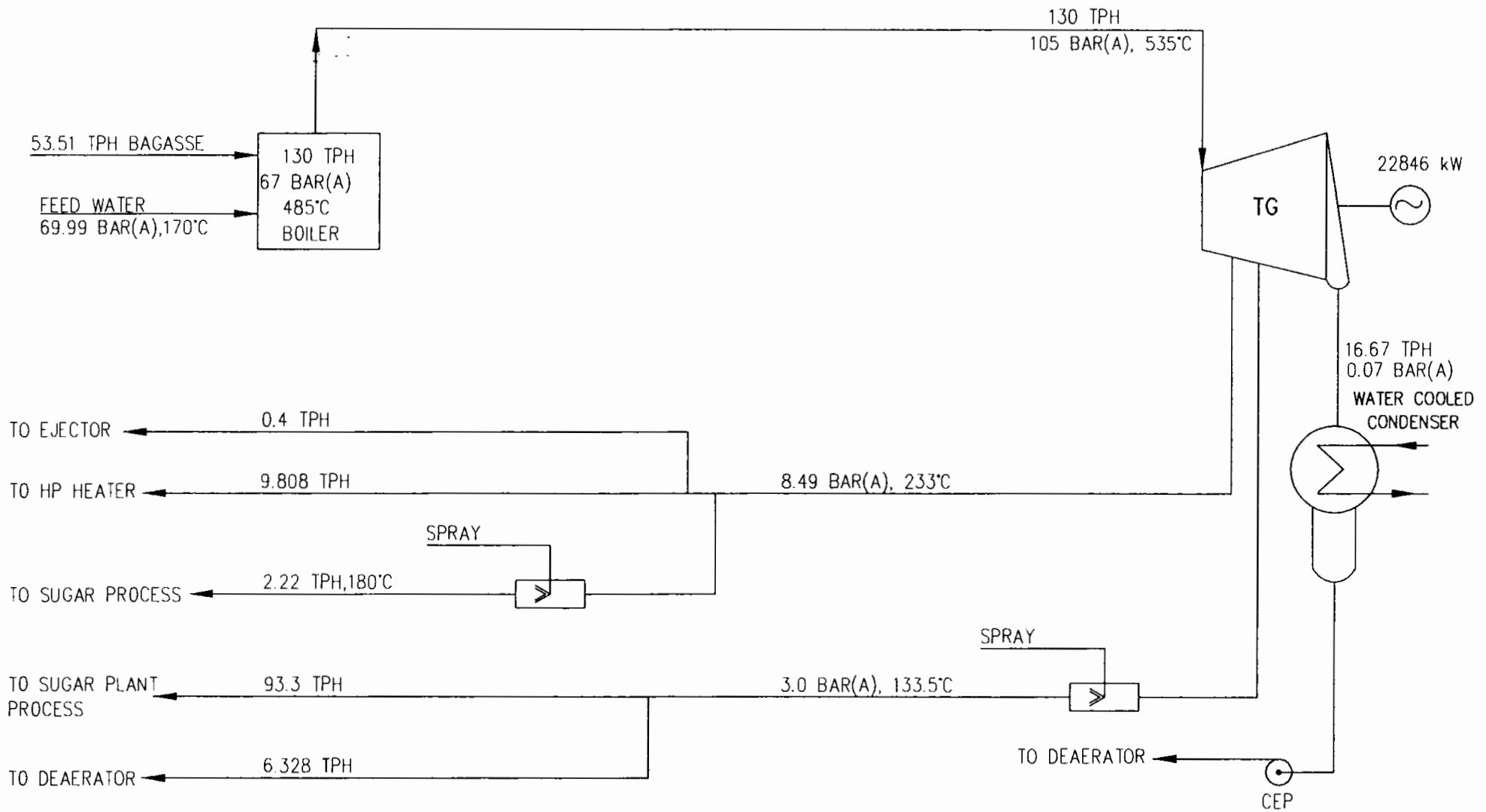
ENGINEERING CONTRACTOR:

AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
TITLE	COGENERATION SCHEME – OFF SEASON OPERATION (ALT-III)

	NAME	SIGN
DRN	S.PRABHU	
CHD	S.SIVAKUMAR	
APPD	S.BALASUBRAMANIAN	

DRAWING NO. FIG III 2



NO.OF UNITS - 3

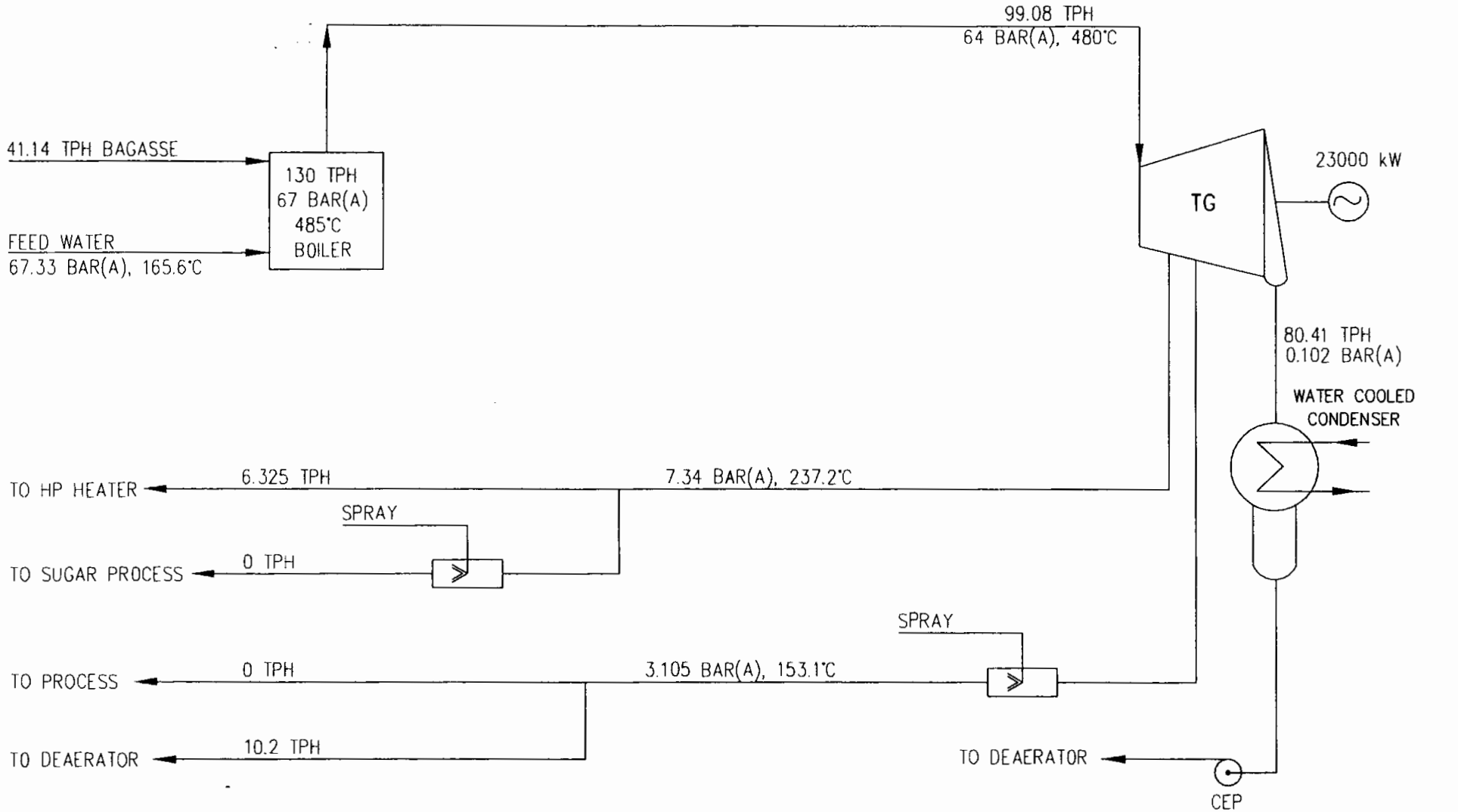
ENGINEERING CONTRACTOR:

AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
	COGENERATION SCHEME - SEASON OPERATION (ALT-IV)

	NAME	SIGN
DRN	S.PRABHU	
CHD	S.SIVAKUMAR	
APPD	S.BALASUBRAMANIAN	

DRAWING NO. FIG IV.1



NO.OF UNITS – 3

ENGINEERING CONTRACTOR:

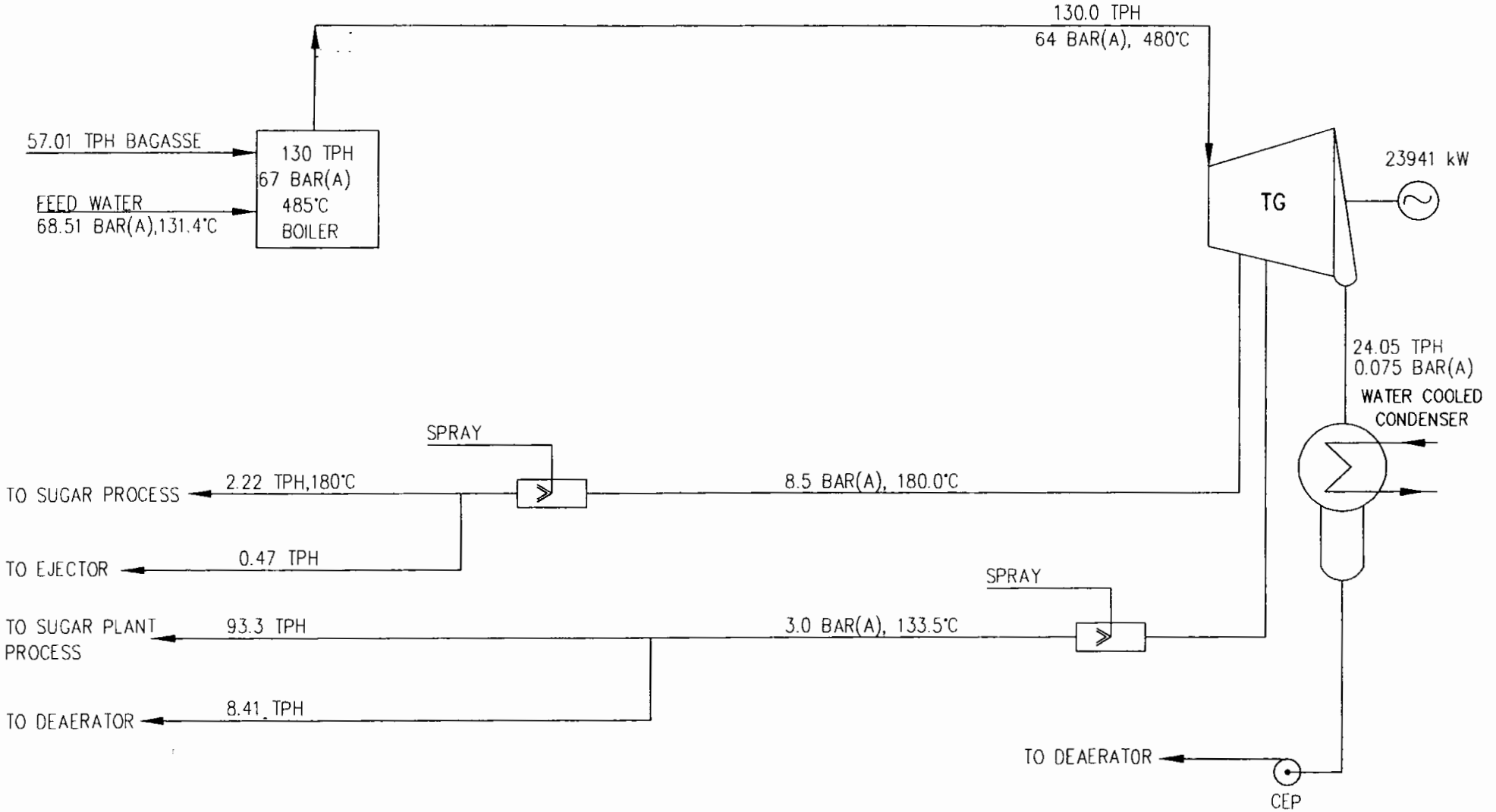
AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
TITLE	COGENERATION SCHEME – OFF SEASON OPERATION (ALT-IV)

	NAME	SIGN
DRN	S.PRABHU	
CHD	S.SIVAKUMAR	
APPD	S.BALASUBRAMANIAN	

DRAWING NO.

FIG.IV.2



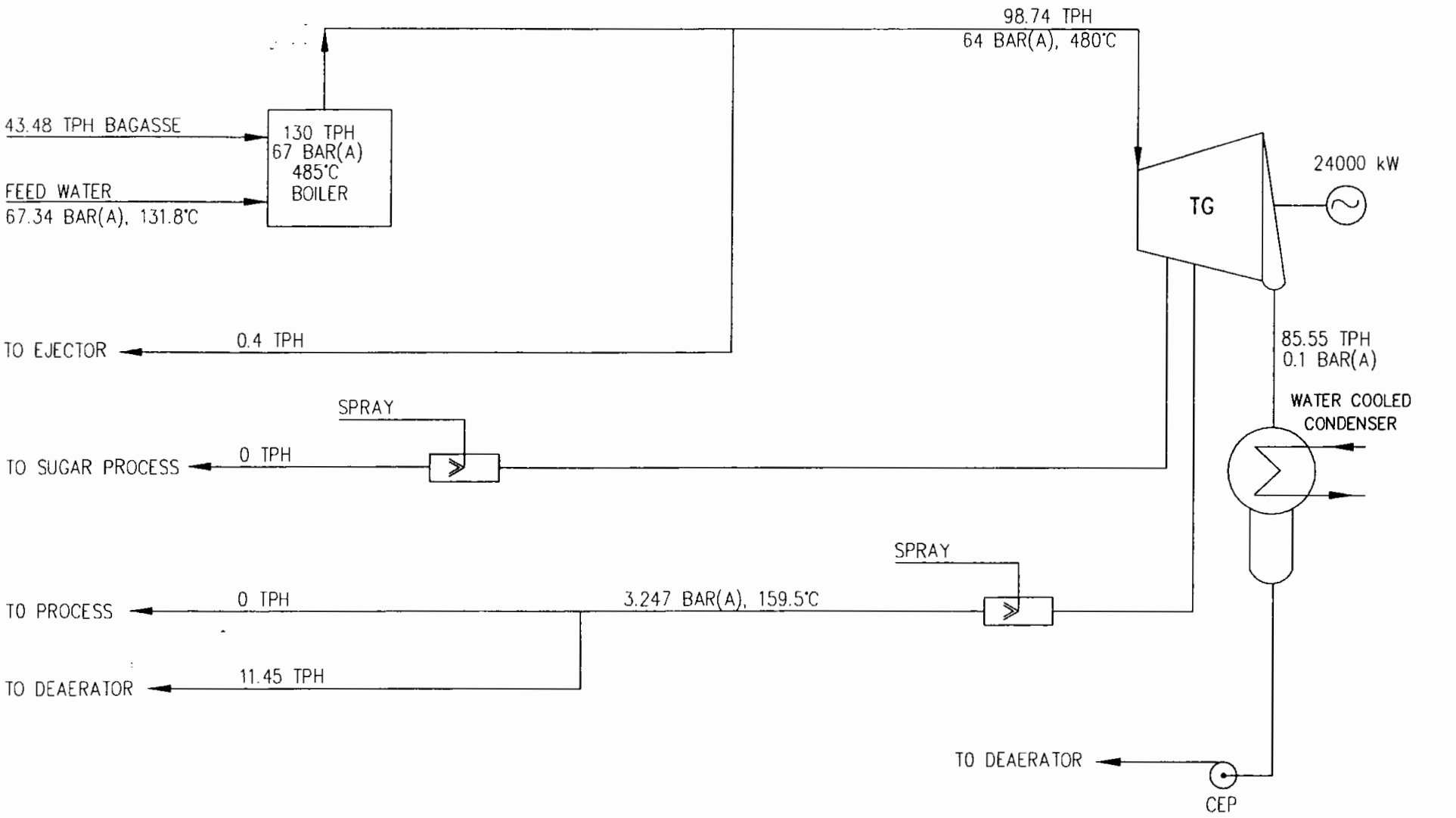
NO.OF UNITS – 3

ENGINEERING CONTRACTOR:
AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
	COGENERATION SCHEME – SEASON OPERATION (ALT-V)

	NAME	SIGN
DRN	S.PRABHU	
CHD	S.SIVAKUMAR	
APPD	S.BALASUBRAMANIAN	

DRAWING NO. FIG V 1



NO.OF UNITS - 3

ENGINEERING CONTRACTOR:
AVANT-GARDE
ENGINEERS AND CONSULTANTS (P) LTD.
CHENNAI 600 116, INDIA.

CUSTOMER	SHEIKHOO SUGAR MILLS LTD.,
PROJECT	BAGASSE BASED COGENERATION PROJECT
PROJECT CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC), SHARJAH, UAE
	COGENERATION SCHEME – OFF SEASON OPERATION (ALT-V)

	NAME	SIGN
DRN	S.PRABHU	
CHD	S.SIVAKUMAR	
APPD	S.BALASUBRAMANIAN	

DRAWING NO. FIG V.2

Location maps, site maps, land

PLANT LOCATION

The proposed plant of Sheikhoo Power (Pvt.) Limited is located in an excellent cane growing area of Tehsil Kot Addu, District Muzaffargarh, Punjab Province. The proposed plant is about 8 Km from the Sanawan city. The nearest airport is at Multan airport and the nearest sea port is Karachi at a distance of about **920** Km.

A picture of Plant Proposed Location from Google Map

Longitude	Latitude	Elevation
71°3'28.35"E	30°17'59.84"N	433ft

•

Technology, Size of plant, number of units

INFORMATION FOR CHECK LIST

Sl.No.	Description	Detail
3(5)(g)(a)	The type, technology, model, technical details and design of the facilities proposed to be acquired, constructed, developed or installed	Boiler - Travelling grate type, Bagasse fired Boiler of capacity 150 TPH with steam outlet parameters of 110 Bar(a) and 540 Deg.C TG - Double extraction cum condensing TG with water cooled condenser of capacity 30 MW.
Schedule III		
2	Technology, size of plant , number of units	1 No. of unit of 30 MW.
4	Emission values	SOx (mg/Nm3) - 412 NOx (mg/Nm3) - Less than 80 ppm CO2 - NIL CO (mg/Nm3) - NIL PM - 50 mg/Nm3
5	Cooling water source tube wells, sea, river, canal distance from source etc.	RCC counter flow cooling tower of capacity 6800 Cu.M/Hr
11	Safety plans, emergency plans	High velcoity spray system shall be installed in Bagasse storage area, Transformers and switchyard.
13	Plant characteristics: generation voltage, power factor, frequency, automatic generation control, ramping rate, control metering and instrumentation	Generation Voltage - 11000 Volts Frequency - 50 Hz Power Factor - 0.8 (lag) Automatic Generation (AGC)- Through Woodward Control Governor Ramping Rate & time required to synchronize to grid - i. During Hot start – 53 minutes - ii. During Warm start – 80 minutes - iii. During cold start – 130 minutes (If turbine is started within 72 hours after shutdown) - iv. During Cold start – 150 minutes (If turbine is started later than 72 hours after shutdown)

14	Control, metering, instrumentation and protection	Refer the following enclosed drawings: a. Protection, Metering & Control schematic diagram for 11kV & 132kV System (Drg. No. 0-15212-900-0462, Rev-0) b. Overall Key Single line diagram (Drg. No. 1-15212-900-0463, Rev-0)

- **Fuel, type, imported / indigenous, supplier, logistics, pipelines etc.**

Schedule "
No. 2

SHEIKHOO SUGAR MILLS LIMITED

- ***Fuel Type, Imported indigenous, Supplier, Logistics, Pipelines etc.***

The fuel to be used shall be Baggasse which will be produced in house. There will be no imported material and it is totally indigenous.

Emission values

INFORMATION FOR CHECK LIST

Sl.No.	Description	Detail
3(5)(g)(a)	The type, technology, model, technical details and design of the facilities proposed to be acquired, constructed, developed or installed	Boiler - Travelling grate type, Bagasse fired Boiler of capacity 150 TPH with steam outlet parameters of 110 Bar(a) and 540 Deg.C TG - Double extraction cum condensing TG with water cooled condenser of capacity 30 MW.
Schedule III		
2	Technology, size of plant , number of units	1 No. of unit of 30 MW.
4	Emission values	SOx (mg/Nm3) - 412 NOx (mg/Nm3) - Less than 80 ppm CO2 - NIL CO (mg/Nm3) - NIL PM - 50 mg/Nm3
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13	Plant characteristics: generation voltage, power factor, frequency, automatic generation control, ramping rate, control metering and instrumentation	Generation Voltage - 11000 Volts Frequency - 50 Hz Power Factor - 0.8 (lag) Automatic Generation (AGC)- Through Woodward Control Governor Ramping Rate & time required to synchronize to grid - i. During Hot start – 53 minutes - ii. During Warm start – 80 minutes - iii. During cold start – 130 minutes (If turbine is started within 72 hours after shutdown) - iv. During Cold start – 150 minutes (If turbine is started later than 72 hours after shutdown)

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- Cooling water source: tube wells, sea/river/canal, distance from source, etc.

INFORMATION FOR CHECK LIST

Sl.No.	Description	Detail
3(5)(g)(a)	The type, technology, model, technical details and design of the facilities proposed to be acquired, constructed, developed or installed	Boiler - Travelling grate type, Bagasse fired Boiler of capacity 150 TPH with steam outlet parameters of 110 Bar(a) and 540 Deg.C TG - Double extraction cum condensing TG with water cooled condenser of capacity 30 MW.
Schedule III		
2	Technology, size of plant , number of units	1 No. of unit of 30 MW.
4	Emission values	SOx (mg/Nm3) - 412 NOx (mg/Nm3) - Less than 80 ppm CO2 - NIL CO (mg/Nm3) - NIL PM - 50 mg/Nm3
5	Cooling water source tube wells, sea, river, canal distance from source etc.	RCC counter flow cooling tower of capacity 6800 Cu.M/Hr
11	Safety plans, emergency plans	High velcoity spray system shall be installed in Bagasse storage area, Transformers and switchyard.
13	Plant characteristics: generation voltage, power factor, frequency, automatic generation control, ramping rate, control metering and instrumentation	Generation Voltage - 11000 Volts Frequency - 50 Hz Power Factor - 0.8 (lag) Automatic Generation (AGC)- Through Woodward Control Governor Ramping Rate & time required to synchronize to grid - i. During Hot start – 53 minutes - ii. During Warm start – 80 minutes - iii. During cold start – 130 minutes (If turbine is started within 72 hours after shutdown) - iv. During Cold start – 150 minutes (If turbine is started later than 72 hours after shutdown)

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- Interconnection with National Grid Co. distance and name of nearest grid, voltage level (Single Line Diagram)

MULTAN ELECTRIC POWER COMPANY LIMITED

Tel #. 9220192
Fax #. 9220249

Office of the
Chief Executive
MEPCO Ltd, Multan

Memo No. 16309-12/C.E (P&E) Dated 20 FEB 2016

CHIEF ENGINEER/C.S DIRECTOR
MEPCO Ltd. MULTAN

SUB: - **Electrical Grid Studies for 30MW, Bagasse Based Thermal Power Project by Sheikhoo Power (Pvt.) Limited at Muzaffargarh, Punjab, Pakistan**

Ref: - **Chief Engineer/C.S. Director Letter No. 628/CE/MEPCO/CSD/D (MKT)/PP-103/SSML/10326-28 dated February 06, 2016**

The Draft Grid Interconnection Study (GIS) report for 30MW, Bagasse Based Thermal Power Project by Sheikhoo Power (Pvt.) Limited at Muzaffargarh, Punjab, Pakistan have been received vide above subjected letters. After reviewing the said study, the following observations were pointed out:

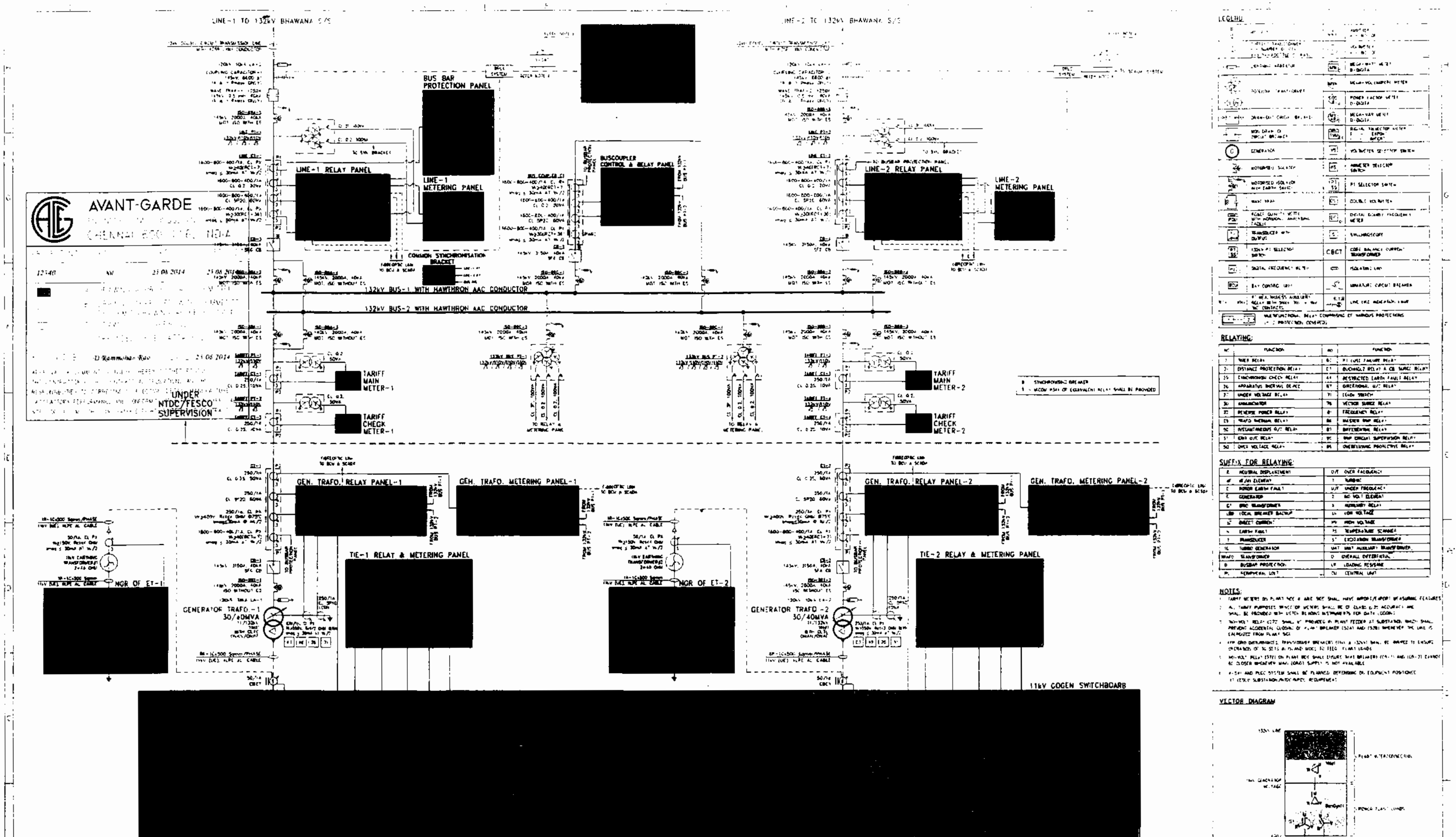
- In future peak load case (September 2021), there is capacity constraint in the area of Sheikhoo PP. The transmission line from KAPCO - Gujrat South - Muzaffar Garh-Old became overloaded; when transmission line from Sheikhoo PP to Muzaffar Garh- Old is switched off (N-1 contingency).
- In order to ensure reliable power evacuation and to solve problem of overloading during N-1 contingency, Consultant has proposed **"Re-conductoring of existing SC transmission line from KAPCO-Gujrat South-Muzaffar Garh-Old from LYNX to Rail conductor and stringing of second circuit on Rail on same circuit towers".**
- Moreover, in the future year 2021, the consultant has also recommended change in T-Off (Junction) point (Annex-A), which would result into feeding 132 KV Industrial Estate only from 220/132 KV Muzaffargarh Grid Station and its direct connection from 220/132 KV KAPCO Grid Station will be lost.

In light of above mentioned proposed reinforcements, it is therefore requested to obtain opinion of CE (T&G) and CE (Dev.) regarding the practical implementation, timeline and its feasibility (ROW) in order to proceed further in this matter.

Chief Engineer (P&E)
MEPCO Ltd, Multan

CC :

I. Chief Engineer (Dev.), MEPCO Ltd. Multan
II. Executive Director, Sheikhoo Power (Pvt.) Limited. F-11, Phase-I, Commercial Area, DHA, Lahore
III. ARCO Energy, 229 Alfalah Building, Mall Road, Lahore, Pakistan.



		REVISED AS PER CLIENT COMMENTS	SB	BM	SBC
0		ISSUED FOR APPROVAL	SB	BM	SBC
REV	DATE	REVISION	DRAWN	CHKD	APPD

CLIENT	CHINIOT POWER LIMITED - PAKISTAN
CONSULTANT	AVANT-GARDE ENGINEERS & CONSULTANTS (FZC),SHARJAH
PROJECT	BAGASSE BASED COGENERATION PROJECT- 2x31.2MW
CONTRACTOR	GREENESOL POWER SYSTEM PVT. LIMITED
TITLE	[redacted]

GPSPL JOB NO P-2008P

DWG NO: 2 0 8 0 P E L 1 0 0 1 — SH 0 1 OF 0 1 — REV 1

GREENESOL POWER SYSTEMS PVT. LTD.

HTC

Infrastructure: roads, rail, staff colony, amenities

SHEIKHOO SUGAR MILLS LIMITED

Infrastructure: Roads, Rail, Staff Colony and Amunities

The company was incorporated as a public limited company on January 03, 1990 under the Companies Ordinance, 1984. The sponsors have contributed the entire equity through 100% investment in foreign exchange.

- ***Location***

The project has been set-up at Muzaffargarh, Punjab. The site enjoys all infrastructure facilities, i.e., quick & fast transport, communication facilities, raw material, availability of skilled and unskilled labour. The availability of raw material i.e. sugar cane has increased manifold during last sixteen years due to courtant sugar cane development efforts by Sheikhoo Sugar Mills Limited (SSML).

- ***Plant & Machinery***

The Plant & Machinery of the mills is a mix of local and imported machines. The cane crushing systems, boilers and process house machines are mostly locally procured, where the powerhouse turbines and generators are imported from Peter Brotherhood. Sheikhoo Sugar Mills Limited has one of the most sophisticated imported computerized refineries for refining the sugar. This machinery is imported from Tate & Lyle United Kingdom.

- ***Civil Work***

The civil work of the project comprise of the main factory building, Administration block, officers and labour residences, mosque, sugar godown, workshop, cane office and yard, store, gate office, boundary wall, overhead water tank, sewerage, drainage and external water supply system. The construction is of RCC type.

- ***Technical Know How and Manpower***

The company has hired highly qualified and experienced persons to supervise the finance, cane, technical, and administration departments of the company. The accounting system including cane accounting is entirely computerized.

- ***Project Operations***

The trial production was commenced on 13th November '94 and commercial production on 1st January '95. initially the mills' cane crushing capacity was 4,000 TCD which has been expanded to 12,000 tones TCD from 1997 to 2011. Currently Sheikhoo Sugar Mills Limited has the crushing capacity of 16,000 TCD. The plant & machinery has imported/Local for this purpose is financed by internal generation of SSML.

- **Project cost, information regarding sources and amounts of equity, debt.**

SHEIKHOO POWER (PVT) LIMITED

Project cost, information regarding sources and amount of Equity: Debt.

The total project cost of the project is US$34.892 million translated at Rs. 112 per US$ comes to Rs. 3.906 billion.

Sources of Debt:		At 112	At 105
Syndicate Loan:	80%	Rs. 3.125	Rs. 2.930
Equity:	20%	Rs. 0.781	Rs. 0.732
Total	**100%**	**Rs. 3.906**	**Rs. 3.662**

The amount of the equity shall be contributed by Sheikhoo Sugar Mills Limited from its internal cash generation.

SHEIKHOO POWER PROJECT COST 03/09/2016			
S.NO.	DESCRIPTION	AMOUNT IN Million USD	AMOUNT IN Million PKR
A. CIVIL WORKS			
1	This cost includes construction TG building, boiler foundation, Water Treatment Plant building, various equipment foundations in the cogeneration plant.	3.000	336.000
	TOTAL FOR CIVIL WORKS	**3.000**	**336.000**
B. MECHANCIAL WORKS			
1	1 x 155 TPH steam genertor including field instrumentation, fans, pumps, valves specialities, piping, PRDS & auxiliaries	8.000	896.000
2	1 x 30 MW extraction cum condensing turbogenerator unit including all auxiliaries, piping, governor, control, instrumentation and electrical	4.500	504.000
3	Bagasse handling, conveyar components, structurals, hoods etc.,	0.540	60.480
4	Ash handling system	0.600	67.200
5	Induced draft cooling tower with RCC WORK	0.500	56.000
6	Pumps with base frames and electric motor drives	0.400	44.800
7	Steam, Water piping and valves & supports	1.500	168.000
8	Reverse Osmosis based water Treatment Plant (borewell water) with tanks	0.677	75.824
9	EOT Crane for TG building	0.150	16.800
10	Air Conditioning system & Ventilation system	0.430	48.160
11	Air Compressors	0.070	7.840
12	Fire Protection Systems	0.500	56.000
13	Distributed Contral Systems & Misc. instrumentation other than that covered by packages & UPS	1.000	112.000

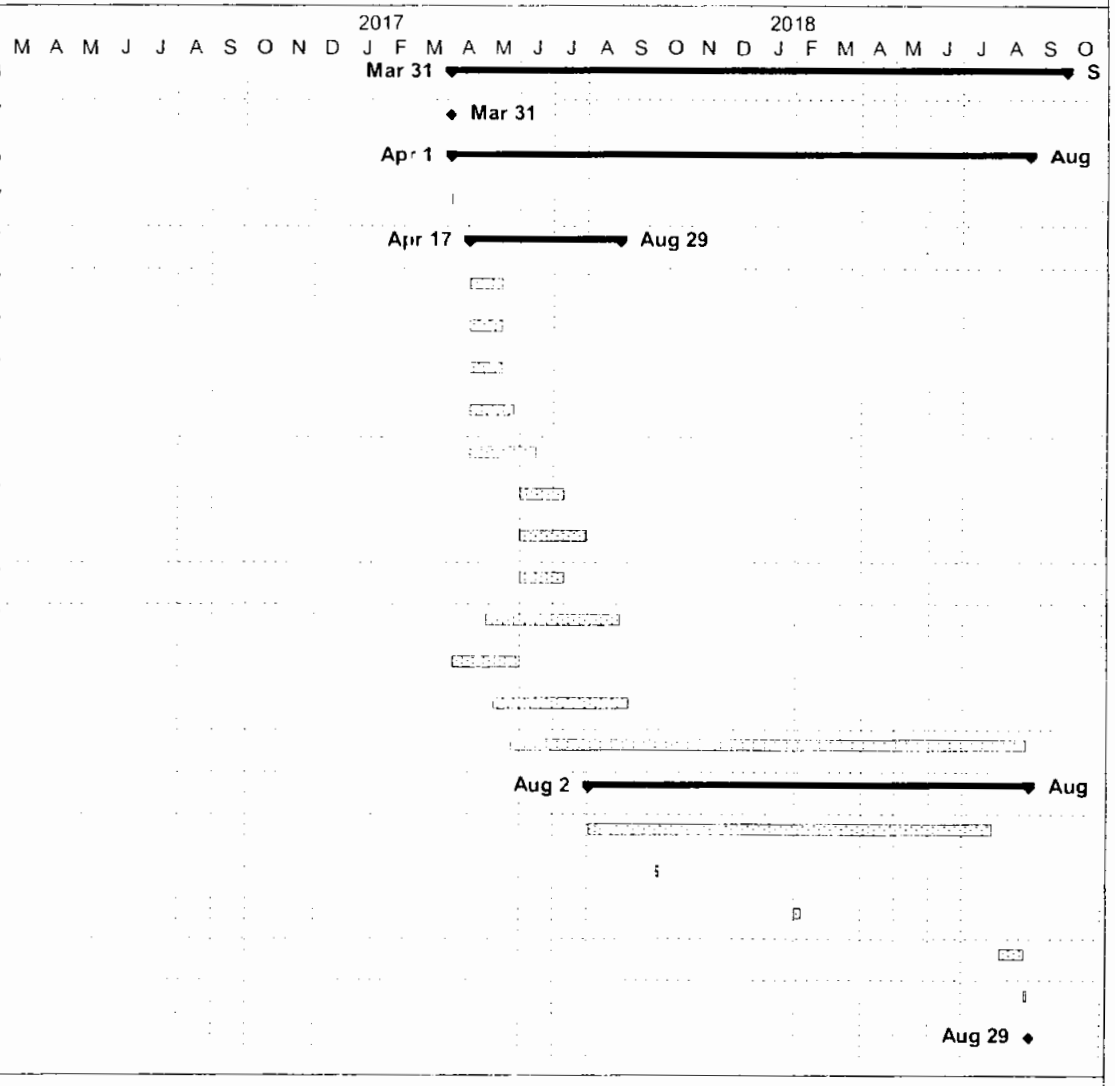
SHEIKHOO POWER PROJECT COST 03/09/2016			
S.NO.	DESCRIPTION	AMOUNT IN Million USD	AMOUNT IN Million PKR
14	Erection/ Installation/ Commissioning	1.300	145.600
15	Spares	0.300	33.600
16	Lab. Equipments	0.053	5.936
	TOTAL FOR MECHANICAL WORKS	**20.520**	**2298.240**
C. ELECTRICAL WORKS			
1	30 MW Generators & all generator accessories including relay, metering and control panels, AVR & NGR Panels of each TG set. Common synchronizing panel and load sharing panel		
2	Switchyard		
2.1	Power transformer (11kv / 132kv)	3.000	336.000
2.2	Plant end Switchyard (132 kV)		
3	Auxiliary Transformers		
3.1	Converter Transformers		
3.2	Distribution Transformers	0.400	44.800
3.3	Interconnection Transformer 11 / 6.6 kV		
4	HT Package		
5	LT Package		
6	VFD Package	1.850	207.200
7	Cables Package		
8	Contracts package (cable tray, LT bus duct. Lighting & Misc. Items)		
9	DG Set Package - 1010 kVA	0.300	33.600
	TOTAL FOR ELECTRICAL WORKS	**5.550**	**621.600**

SHEIKHOO POWER PROJECT COST 03/09/2016			
S.NO.	DESCRIPTION	AMOUNT IN Million USD	AMOUNT IN Million PKR
	TOTAL WORKS (EPC) COST	**29.070**	**3255.840**
	EPC Cost Per MW	**0.969**	**108.528**
	NON EPC COST		
S.NO.	DESCRIPTION	AMOUNT IN Million USD (EPC Only)	AMOUNT IN Million PKR (EPC Only)
D.	**Additional Project Charges**		
1	Consultancy/Detailed Engineering	0.800	89.600
2	Regulatory Requirements	0.110	12.320
3	Transportation	0.100	11.200
4	Development Charges (Site)	0.100	11.200
5	Insurance Cost	0.244	27.328
6	Contingences And Duties	2.240	250.880
7	Interest During Construction	2.228	249.536
	NON EPC COST	**5.822**	**652.064**
	PROJECT COST	**34.892**	**3907.904**
	PROJECT COST/MW	1.163	
	Dollar Conversion Rate	112	

Project commencement and completion schedule with milestones

SHEIKHOO POWER PRIVATE LIMITED
30 MW Cogeneration Project

ID	Task Name	Duration	Start	Finish
1	**Bagasse Based Cogen Project**	**549 days**	**Mar 31 '17**	**Sep 30 '18**
2	Project Start Date	0 days	Mar 31 '17	Mar 31 '17
3	**Boiler & Auxiliaries**	**516 days**	**Apr 1 '17**	**Aug 29 '18**
4	Order Placement of Boiler & Aux. Equipments	1 day	Apr 1 '17	Apr 1 '17
5	**Submission of Engineering Documents**	**135 days**	**Apr 17 '17**	**Aug 29 '17**
6	GA Drawings	30 days	Apr 17 '17	May 16 '17
7	Loading data	30 days	Apr 17 '17	May 16 '17
8	Boiler Utility List	30 days	Apr 17 '17	May 16 '17
9	Electrical load list	40 days	Apr 17 '17	May 26 '17
10	P&ID for various system	60 days	Apr 17 '17	Jun 15 '17
11	Terminal Point Drawing	40 days	Jun 1 '17	Jul 10 '17
12	Aux Equipment loading data	60 days	Jun 1 '17	Jul 30 '17
13	I/O List	40 days	Jun 1 '17	Jul 10 '17
14	Other documents as per the drawing list	120 days	May 2 '17	Aug 29 '17
15	Opening of LC	60 days	Apr 2 '17	May 31 '17
16	Review & approval of Drawings & Documents	120 days	May 9 '17	Sep 5 '17
17	Manufacturing & Supply	460 days	May 24 '17	Aug 26 '18
18	**Erection & Commissioning**	**393 days**	**Aug 2 '17**	**Aug 29 '18**
19	Erection of Boiler & Auxiliaries	360 days	Aug 2 '17	Jul 27 '18
20	Drum lifting	3 days	Oct 1 '17	Oct 3 '17
21	Hydro Test	6 days	Feb 1 '18	Feb 6 '18
22	Pre Commissioning	22 days	Aug 4 '18	Aug 25 '18
23	Safety valve floating	3 days	Aug 26 '18	Aug 28 '18
24	Ready for Operation	0 days	Aug 29 '18	Aug 29 '18



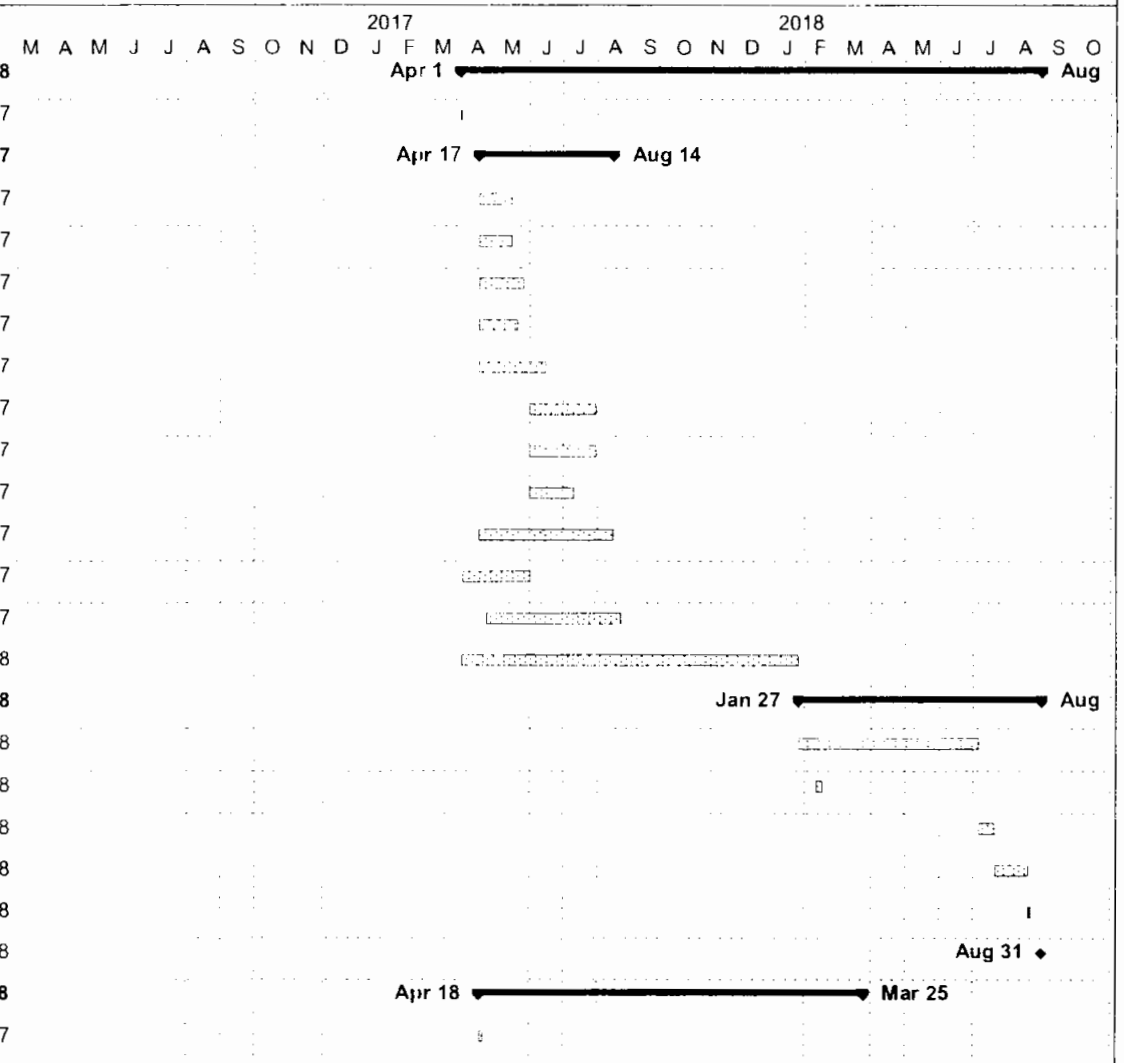
Project :Mirpurkhas

Task — Milestone — Project Summary
Progress — Summary

Prepared by	Checked by	Approved by
S.R.Saipasad	S.Sivakumar	S.Balasubramanian

SHEIKHOO POWER PRIVATE LIMITED
30 MW Cogeneration Project

ID	Task Name	Duration	Start	Finish
25	**TG & Auxiliaries**	**518 days**	**Apr 1 '17**	**Aug 31 '18**
26	Order Placement of TG & Aux. Equipments	1 day	Apr 1 '17	Apr 1 '17
27	**Submission of Engineering Documents**	**120 days**	**Apr 17 '17**	**Aug 14 '17**
28	HBD	30 days	Apr 17 '17	May 16 '17
29	TG Utility List	30 days	Apr 17 '17	May 16 '17
30	Electrical load list	40 days	Apr 17 '17	May 26 '17
31	GA & Loading data	35 days	Apr 17 '17	May 21 '17
32	P&ID for various system	60 days	Apr 17 '17	Jun 15 '17
33	TG Aux Equipment layout	60 days	Jun 1 '17	Jul 30 '17
34	Terminal Point Drawing	60 days	Jun 1 '17	Jul 30 '17
35	I/O List	40 days	Jun 1 '17	Jul 10 '17
36	Other documents as per the drawing list	120 days	Apr 17 '17	Aug 14 '17
37	Opening of LC	60 days	Apr 3 '17	Jun 1 '17
38	Review & approval of Drawings & Documents	120 days	Apr 24 '17	Aug 21 '17
39	Manufacturing & Supply	300 days	Apr 2 '17	Jan 26 '18
40	**Erection & Commissioning**	**217 days**	**Jan 27 '18**	**Aug 31 '18**
41	Erection of TG Auxiliaries	160 days	Jan 27 '18	Jul 5 '18
42	TG onbase	6 days	Feb 11 '18	Feb 16 '18
43	Oil flushing	15 days	Jul 6 '18	Jul 20 '18
44	Pre Commissioning	30 days	Jul 21 '18	Aug 19 '18
45	Barring Gear	2 days	Aug 20 '18	Aug 21 '18
46	Ready for Operation	0 days	Aug 31 '18	Aug 31 '18
47	**Fuel & Ash Handling System**	**342 days**	**Apr 18 '17**	**Mar 25 '18**
48	Review Vendor Inputs	3 days	Apr 18 '17	Apr 20 '17



Project :Mirpurkhas

Task
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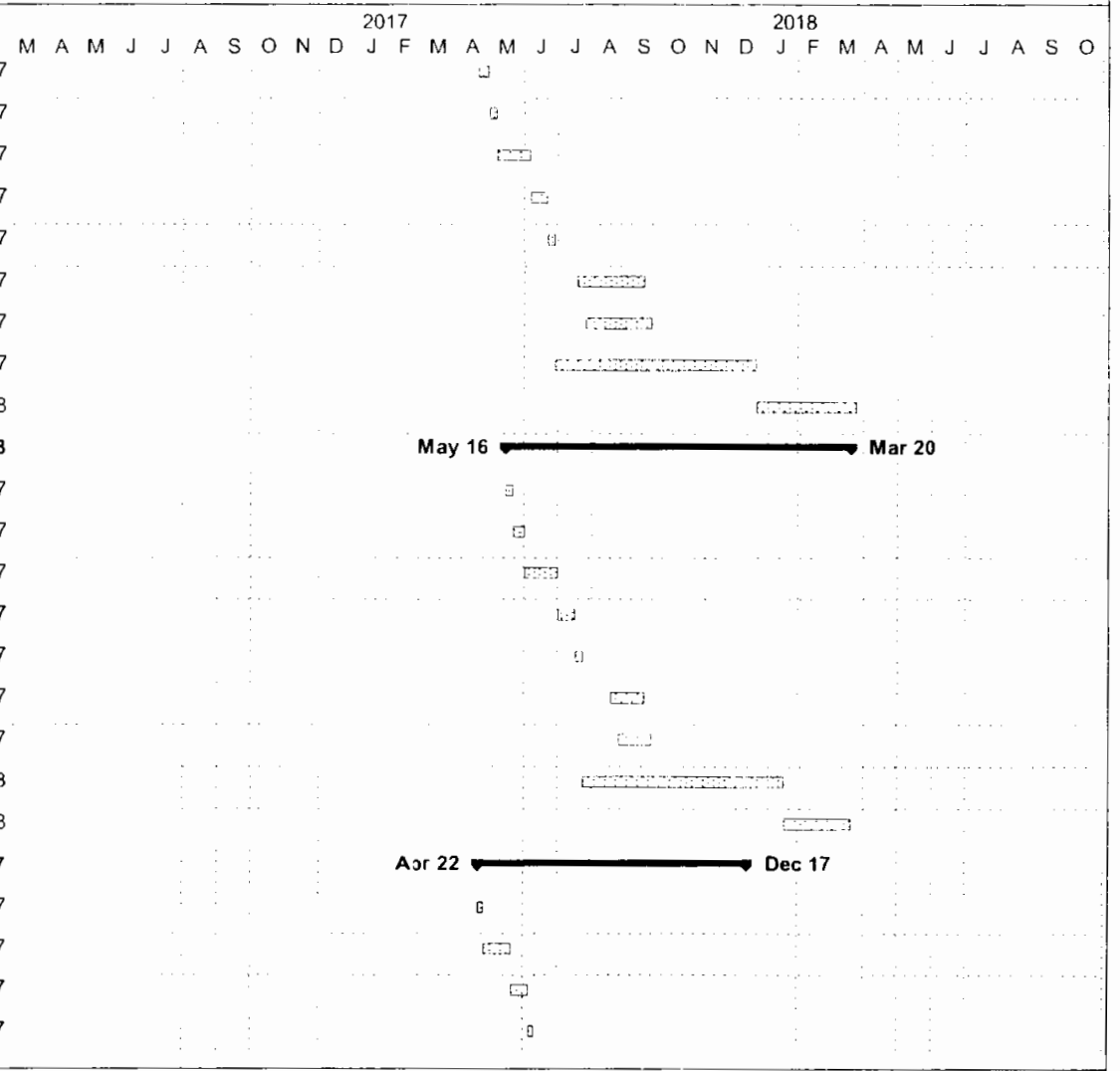
Prepared by S R Saipasad | Checked by S Sivakumar | Approved by S Balasubramanian

ID	Task Name	Duration	Start	Finish
49	Scheme Finalization	10 days	Apr 21 '17	Apr 30 '17
50	Tender Preparation	7 days	May 1 '17	May 7 '17
51	Bid Release & Receipt of Offers	30 days	May 8 '17	Jun 6 '17
52	Review, Clarification & Evaluation	15 days	Jun 7 '17	Jun 21 '17
53	Ordering of Fuel & Ash Handling system	7 days	Jun 22 '17	Jun 28 '17
54	Submission of Engineering Documents	60 days	Jul 19 '17	Sep 16 '17
55	Review and Approval of Documents	60 days	Jul 26 '17	Sep 23 '17
56	Manufacturing & Supply	180 days	Jun 29 '17	Dec 25 '17
57	Erection & Commissioning	90 days	Dec 26 '17	Mar 25 '18
58	**Dense Phase Ash Handling System**	**309 days**	**May 16 '17**	**Mar 20 '18**
59	Scheme finalization	7 days	May 16 '17	May 22 '17
60	Tender Preparation	10 days	May 23 '17	Jun 1 '17
61	Bid Release & Receipt of Offers	30 days	Jun 2 '17	Jul 1 '17
62	Review, Clarification & Evaluation	15 days	Jul 2 '17	Jul 16 '17
63	Ordering of DP Ash Handling system	7 days	Jul 17 '17	Jul 23 '17
64	Submission of Engineering Documents	30 days	Aug 18 '17	Sep 16 '17
65	Review and Approval of Documents	30 days	Aug 25 '17	Sep 23 '17
66	Manufacturing & Supply	180 days	Jul 24 '17	Jan 19 '18
67	Erection & Commissioning	60 days	Jan 20 '18	Mar 20 '18
68	**EOT Crane**	**240 days**	**Apr 22 '17**	**Dec 17 '17**
69	Tender Preparation	5 days	Apr 22 '17	Apr 26 '17
70	Bid Release & Receipt of Offers	25 days	Apr 27 '17	May 21 '17
71	Review, Clarification & Evaluation	15 days	May 22 '17	Jun 5 '17
72	Ordering of EOT Crane	5 days	Jun 6 '17	Jun 10 '17



Project :Mirpurkhas

Task — Milestone — Project Summary
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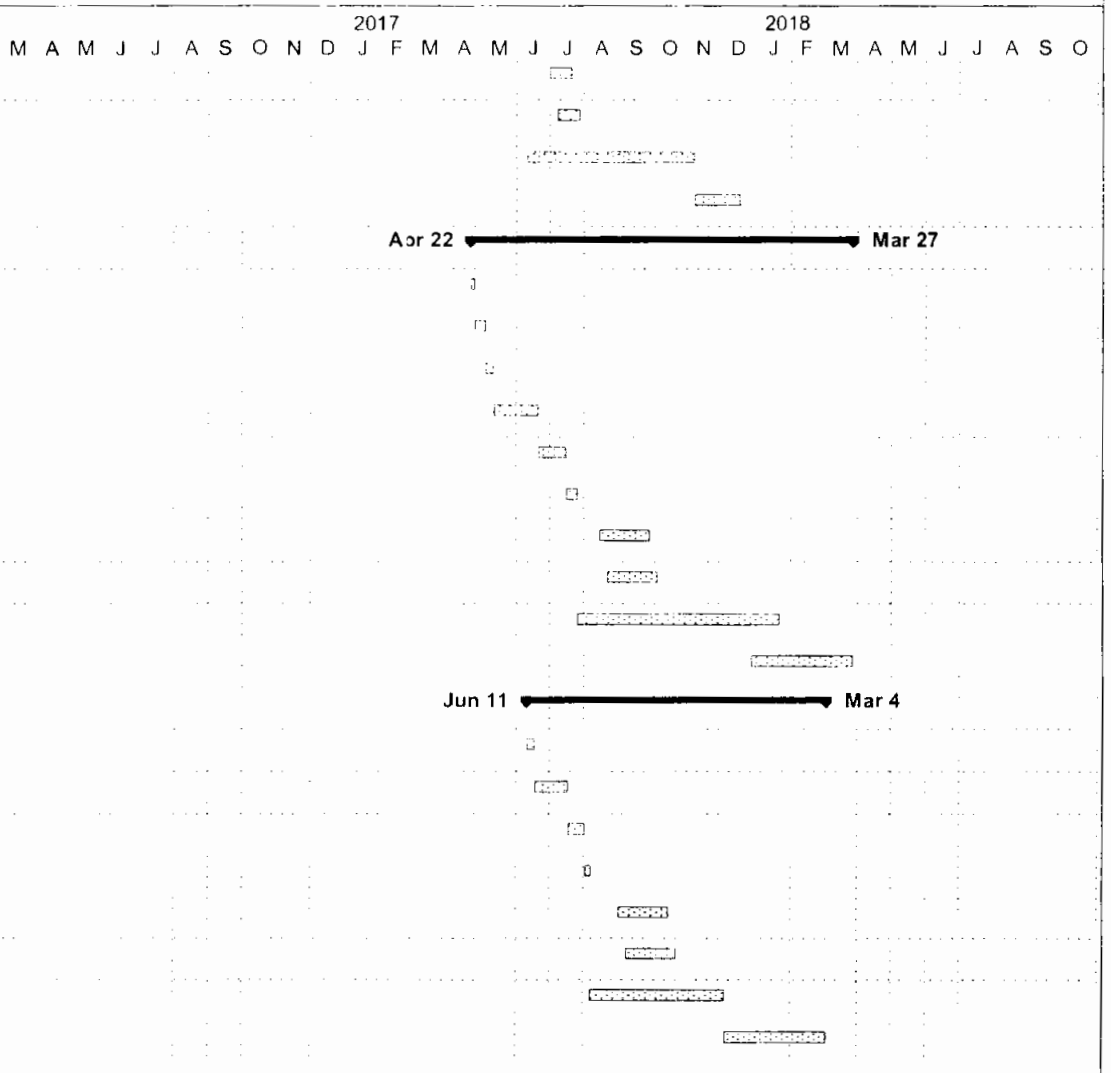
Prepared by S.R.Saipasad | Checked by S.Sivakumar | Approved by S.Balasubramanian

SHEIKHOO POWER PRIVATE LIMITED
30 MW Cogeneration Project

ID	Task Name	Duration	Start	Finish
73	Submission of Engineering Documents	20 days	Jul 1 '17	Jul 20 '17
74	Review and Approval of Documents	20 days	Jul 8 '17	Jul 27 '17
75	Manufacturing & Supply	150 days	Jun 11 '17	Nov 7 '17
76	Erection & Commissioning	40 days	Nov 8 '17	Dec 17 '17
77	**Water Treatment Plant**	**340 days**	**Apr 22 '17**	**Mar 27 '18**
78	Review Utility List	3 days	Apr 22 '17	Apr 24 '17
79	Scheme finalization	10 days	Apr 25 '17	May 4 '17
80	Tender Preparation	7 days	May 5 '17	May 11 '17
81	Bid Release & Receipt of Offers	40 days	May 12 '17	Jun 20 '17
82	Review, Clarification & Evaluation	25 days	Jun 21 '17	Jul 15 '17
83	Ordering of WTP Package	10 days	Jul 16 '17	Jul 25 '17
84	Submission of Engineering Documents	45 days	Aug 15 '17	Sep 28 '17
85	Review and Approval of Documents	45 days	Aug 22 '17	Oct 5 '17
86	Manufacturing & Supply	180 days	Jul 26 '17	Jan 21 '18
87	Erection & Commissioning	90 days	Dec 28 '17	Mar 27 '18
88	**Cooling Tower**	**267 days**	**Jun 11 '17**	**Mar 4 '18**
89	Sizing & Tender Preparation	7 days	Jun 11 '17	Jun 17 '17
90	Bid Release & Receipt of Offers	30 days	Jun 18 '17	Jul 17 '17
91	Review, Clarification & Evaluation	15 days	Jul 18 '17	Aug 1 '17
92	Ordering of Aux. Cooling Tower	5 days	Aug 2 '17	Aug 6 '17
93	Submission of Engineering Documents	45 days	Sep 1 '17	Oct 15 '17
94	Review and Approval of Documents	45 days	Sep 8 '17	Oct 22 '17
95	Manufacturing & Supply	120 days	Aug 7 '17	Dec 4 '17
96	Erection of Aux. Cooling Tower	90 days	Dec 5 '17	Mar 4 '18



Project :Mirpurkhas

Task — Milestone — Project Summary
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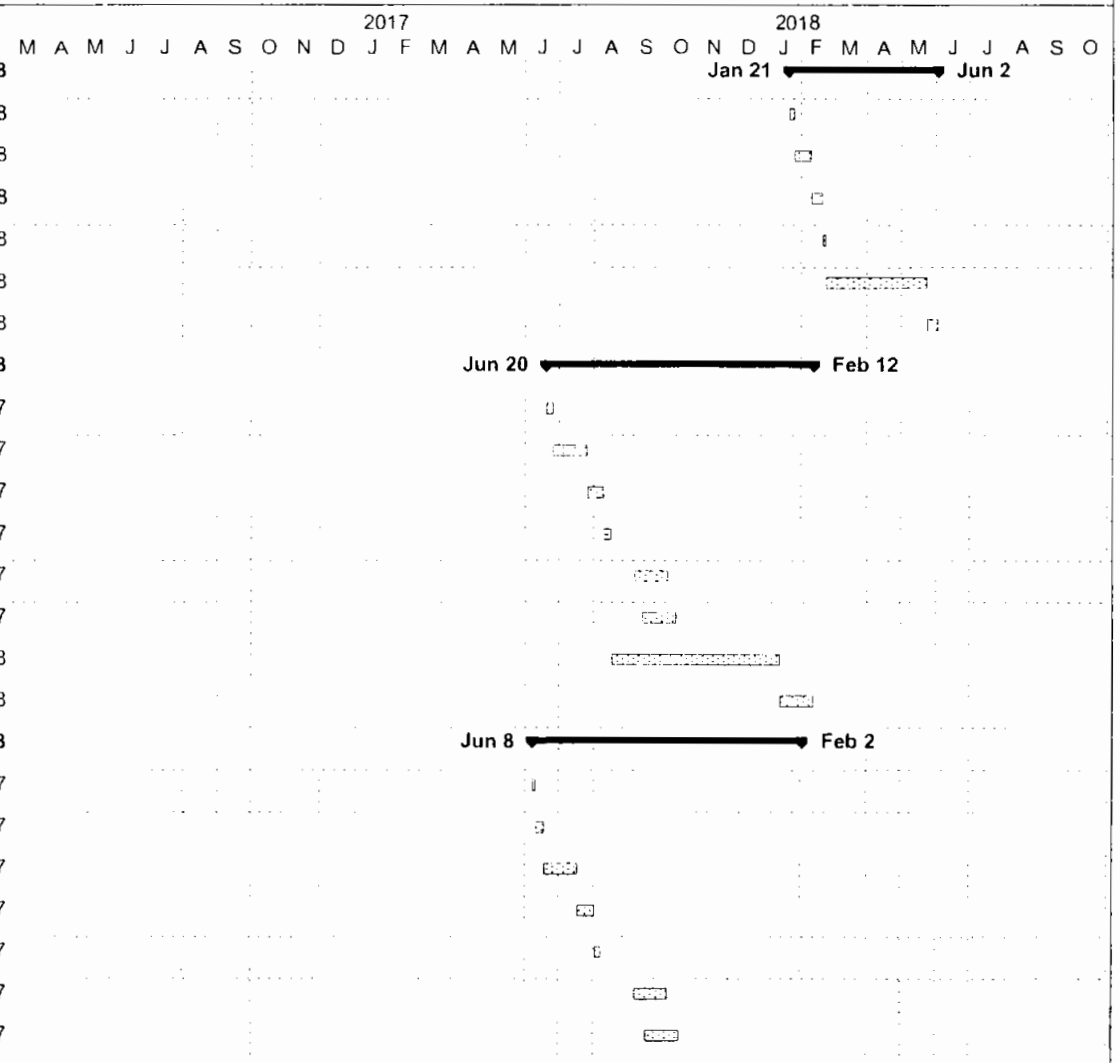
Prepared by S.R.Saipasad | Checked by S.Sivakumar | Approved by S.Balasubramanian

ID	Task Name	Duration	Start	Finish
97	**CW Chemical Treatment**	**133 days**	**Jan 21 '18**	**Jun 2 '18**
98	Tender Preparation	5 days	Jan 21 '18	Jan 25 '18
99	Bid Release & Receipt of Offers	15 days	Jan 26 '18	Feb 9 '18
100	Review, Clarification & Evaluation	10 days	Feb 10 '18	Feb 19 '18
101	Ordering of CWCT System	3 days	Feb 20 '18	Feb 22 '18
102	Manufacturing & Supply	90 days	Feb 23 '18	May 23 '18
103	Erection & Commissioning	10 days	May 24 '18	Jun 2 '18
104	**Centrifugal Pumps & Drives**	**238 days**	**Jun 20 '17**	**Feb 12 '18**
105	Tender Preparation	6 days	Jun 20 '17	Jun 25 '17
106	Bid Release & Receipt of Offers	30 days	Jun 26 '17	Jul 25 '17
107	Review, Clarification & Evaluation	15 days	Jul 26 '17	Aug 9 '17
108	Ordering of Centrifugal Pumps & Drives	7 days	Aug 10 '17	Aug 16 '17
109	Submission of Engineering Documents	30 days	Sep 6 '17	Oct 5 '17
110	Review and Approval of Documents	30 days	Sep 13 '17	Oct 12 '17
111	Manufacturing & Supply	150 days	Aug 17 '17	Jan 13 '18
112	Erection of Pumps	30 days	Jan 14 '18	Feb 12 '18
113	**Air Compressors & Driers**	**240 days**	**Jun 8 '17**	**Feb 2 '18**
114	Review Utility List	3 days	Jun 8 '17	Jun 10 '17
115	Tender Preparation	7 days	Jun 11 '17	Jun 17 '17
116	Bid Release & Receipt of Offers	30 days	Jun 18 '17	Jul 17 '17
117	Review, Clarification & Evaluation	15 days	Jul 18 '17	Aug 1 '17
118	Ordering of Air Compressors & Driers	5 days	Aug 2 '17	Aug 6 '17
119	Submission of Engineering Documents	30 days	Sep 6 '17	Oct 5 '17
120	Review and Approval of Documents	30 days	Sep 16 '17	Oct 15 '17



Project :Mirpurkhas

Task
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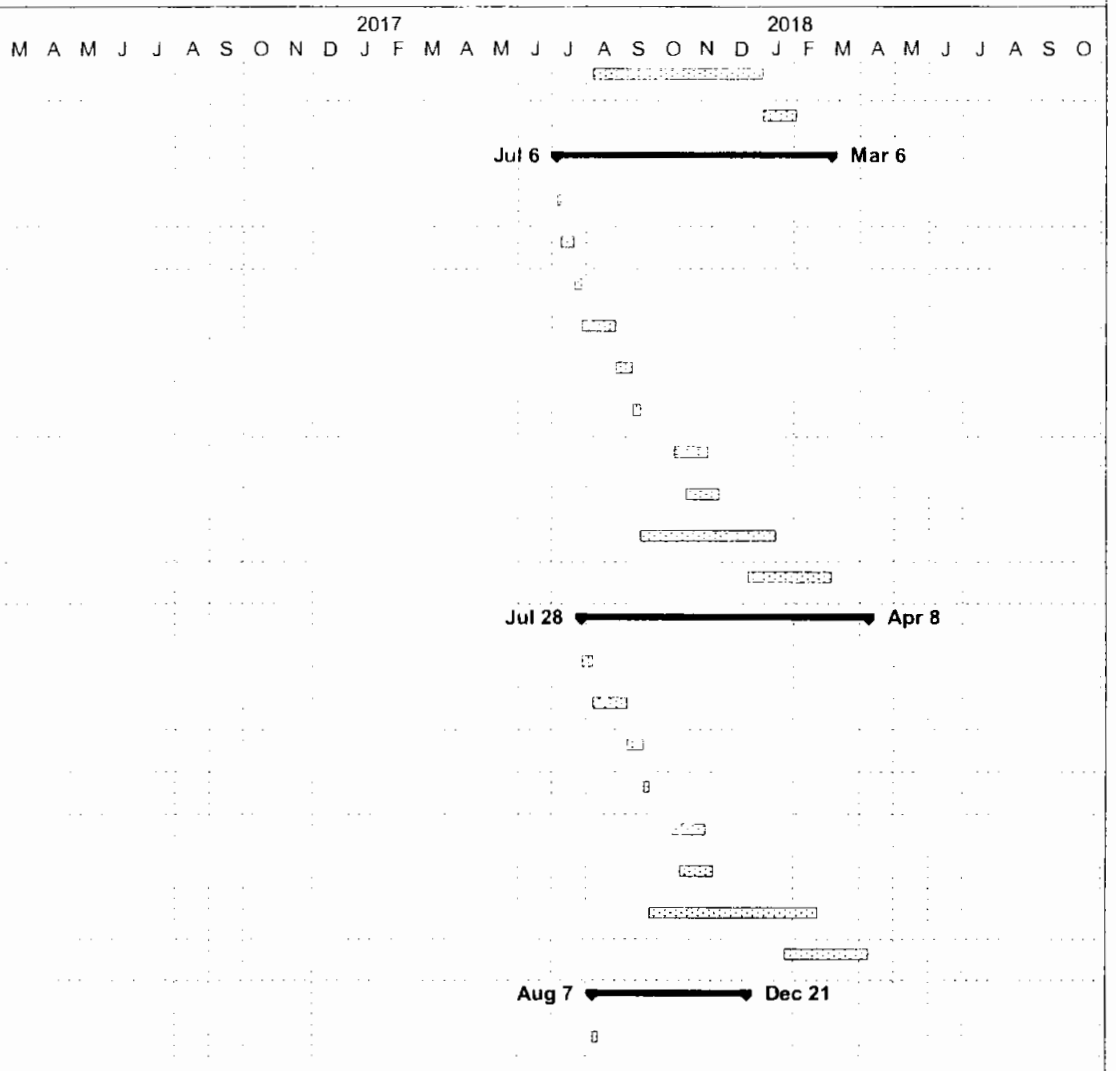
Prepared by S.R.Saipasad
Checked by S.Sivakumar
Approved by S.Balasubramanian

ID	Task Name	Duration	Start	Finish
121	Manufacturing & Supply	150 days	Aug 7 '17	Jan 3 '18
122	Erection of Air Compressors	30 days	Jan 4 '18	Feb 2 '18
123	**Air-Conditioning and Ventilation System**	**244 days**	**Jul 6 '17**	**Mar 6 '18**
124	Receipt and Review Input data	3 days	Jul 6 '17	Jul 8 '17
125	Scheme & Approval	12 days	Jul 9 '17	Jul 20 '17
126	Tender Preparation	7 days	Jul 21 '17	Jul 27 '17
127	Bid Release & Receipt of Offers	30 days	Jul 28 '17	Aug 26 '17
128	Review, Clarification & Evaluation	15 days	Aug 27 '17	Sep 10 '17
129	Ordering of AC & Ventilation System	7 days	Sep 11 '17	Sep 17 '17
130	Submission of Engineering Documents	30 days	Oct 18 '17	Nov 16 '17
131	Review and Approval of Documents	30 days	Oct 28 '17	Nov 26 '17
132	Manufacturing & Supply	120 days	Sep 18 '17	Jan 15 '18
133	Erection & Commissioning	75 days	Dec 22 '17	Mar 6 '18
134	**Fire Fighting System**	**255 days**	**Jul 28 '17**	**Apr 8 '18**
135	Tender Preparation	10 days	Jul 28 '17	Aug 6 '17
136	Bid Release & Receipt of Offers	30 days	Aug 7 '17	Sep 5 '17
137	Review, Clarification & Evaluation	15 days	Sep 6 '17	Sep 20 '17
138	Ordering of Fire Fighting System	5 days	Sep 21 '17	Sep 25 '17
139	Submission of Engineering Documents	30 days	Oct 16 '17	Nov 14 '17
140	Review and Approval of Documents	30 days	Oct 23 '17	Nov 21 '17
141	Manufacturing & Supply	150 days	Sep 26 '17	Feb 22 '18
142	Erection & Commissioning	75 days	Jan 24 '18	Apr 8 '18
143	**Laboratory Equipments**	**137 days**	**Aug 7 '17**	**Dec 21 '17**
144	Tender Preparation	5 days	Aug 7 '17	Aug 11 '17

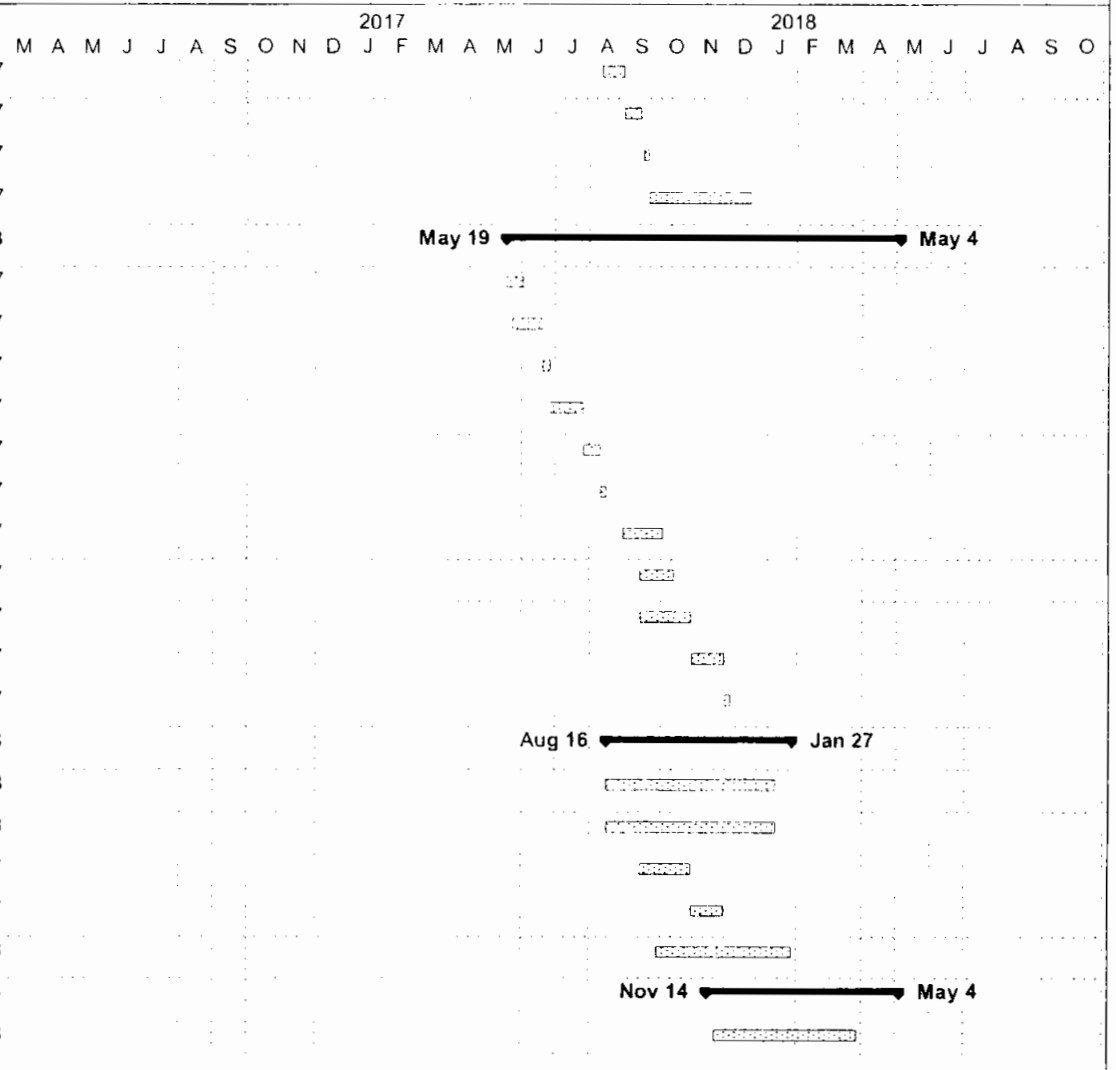


Project :Mirpurkhas

Task — Milestone — Project Summary
Progress — Summary

Prepared by	Checked by	Approved by
S.R Saipasad	S.Sivakumar	S.Balasubramanian

ID	Task Name	Duration	Start	Finish
145	Bid Release & Receipt of Offers	20 days	Aug 12 '17	Aug 31 '17
146	Review, Clarification & Evaluation	15 days	Sep 1 '17	Sep 15 '17
147	Ordering of Laboratory Equipments	5 days	Sep 18 '17	Sep 22 '17
148	Manufacturing & Supply	90 days	Sep 23 '17	Dec 21 '17
149	**Piping package with Accessories**	**351 days**	**May 19 '17**	**May 4 '18**
150	Review Vendor Inputs	15 days	May 19 '17	Jun 2 '17
151	Preparation of off-site P & IDs & Specs.	27 days	May 24 '17	Jun 19 '17
152	Tender Preparation	7 days	Jun 20 '17	Jun 26 '17
153	Bid Release & Receipt of Offers	30 days	Jun 27 '17	Jul 26 '17
154	Review, Clarification & Evaluation	15 days	Jul 27 '17	Aug 10 '17
155	Ordering of Piping Packages	5 days	Aug 11 '17	Aug 15 '17
156	Issue of final Piping Layout to Contractor	35 days	Aug 31 '17	Oct 4 '17
157	Stress Analysis	30 days	Sep 15 '17	Oct 14 '17
158	Pipe Support Engineering	45 days	Sep 15 '17	Oct 29 '17
159	Issue of Pipe Support Drawings	30 days	Oct 30 '17	Nov 28 '17
160	Issue of BOQ for Pipe Supports	5 days	Nov 29 '17	Dec 3 '17
161	**Contractor's Activities**	**165 days**	**Aug 16 '17**	**Jan 27 '18**
162	Procurement of Raw Material	150 days	Aug 16 '17	Jan 12 '18
163	Procurement of Bought out Items	150 days	Aug 16 '17	Jan 12 '18
164	Preparation of Isometric Drawings	45 days	Sep 15 '17	Oct 29 '17
165	Preparation of Orthographic Drawing	30 days	Oct 30 '17	Nov 28 '17
166	Piping fabrication	120 days	Sep 30 '17	Jan 27 '18
167	**Erection & Commissioning**	**172 days**	**Nov 14 '17**	**May 4 '18**
168	Erection of Piping	128 days	Nov 20 '17	Mar 27 '18



Project :Mirpurkhas

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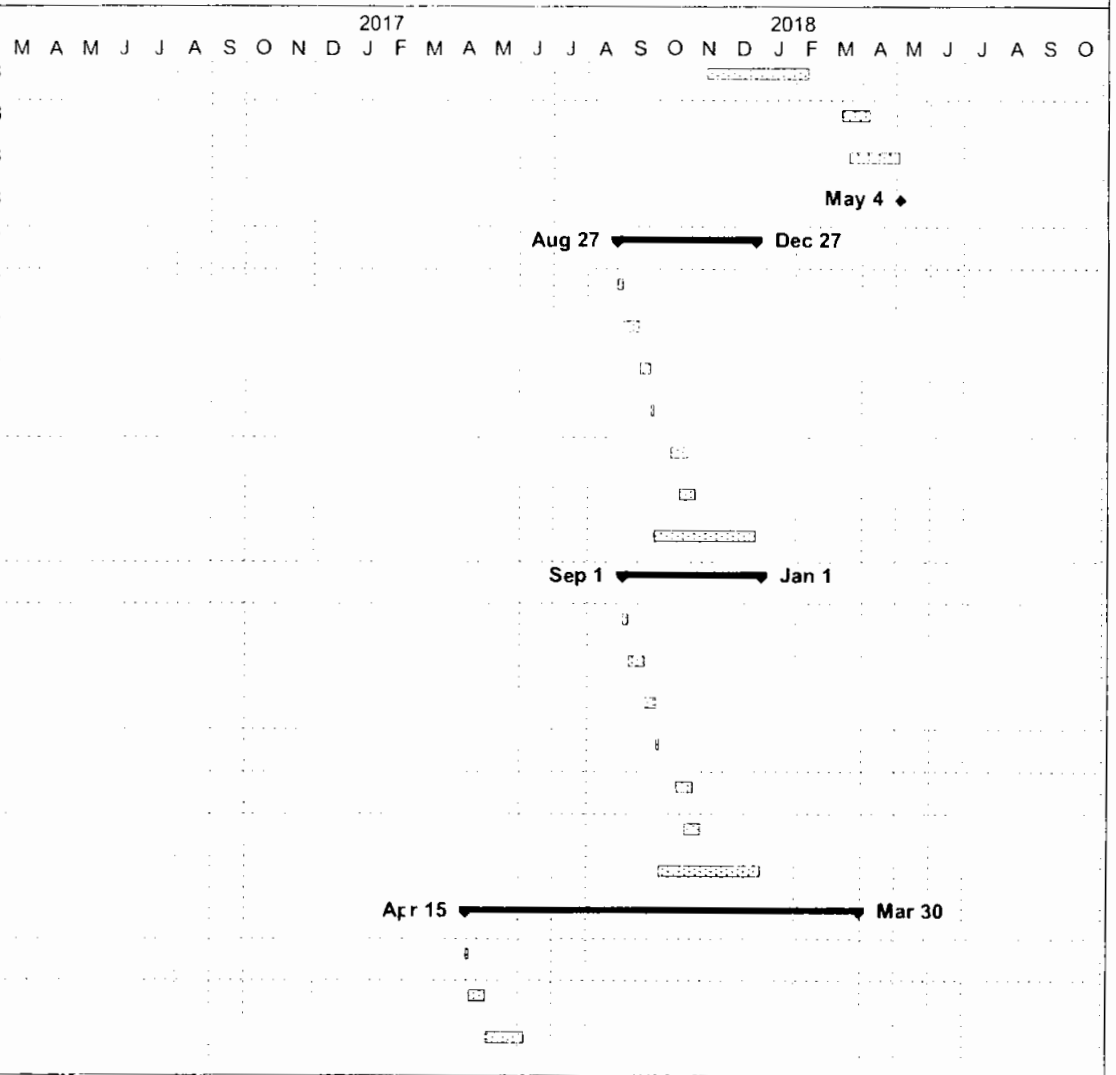
Prepared by S.R.Saipasad | Checked by S.Sivakumar | Approved by S.Balasubramanian

ID	Task Name	Duration	Start	Finish
169	Fabrication & Erection of Tanks	90 days	Nov 14 '17	Feb 11 '18
170	Hydro Test & Flushing	25 days	Mar 13 '18	Apr 6 '18
171	Insulation & Painting	45 days	Mar 20 '18	May 3 '18
172	Ready for Operation	0 days	May 4 '18	May 4 '18
173	**Metallic Bellows**	**123 days**	**Aug 27 '17**	**Dec 27 '17**
174	Tender Preparation	5 days	Aug 27 '17	Aug 31 '17
175	Bid Release & Receipt of Offers	15 days	Sep 1 '17	Sep 15 '17
176	Review, Clarification & Evaluation	10 days	Sep 16 '17	Sep 25 '17
177	Ordering of Metallic Bellows	3 days	Sep 26 '17	Sep 28 '17
178	Submission of Engineering Documents	15 days	Oct 14 '17	Oct 28 '17
179	Review and Approval of Documents	15 days	Oct 21 '17	Nov 4 '17
180	Manufacturing & Supply	90 days	Sep 29 '17	Dec 27 '17
181	**Spring Hangers**	**123 days**	**Sep 1 '17**	**Jan 1 '18**
182	Tender Preparation	5 days	Sep 1 '17	Sep 5 '17
183	Bid Release & Receipt of Offers	15 days	Sep 6 '17	Sep 20 '17
184	Review, Clarification & Evaluation	10 days	Sep 21 '17	Sep 30 '17
185	Ordering of Spring Hangers	3 days	Oct 1 '17	Oct 3 '17
186	Submission of Engineering Documents	15 days	Oct 19 '17	Nov 2 '17
187	Review and Approval of Documents	15 days	Oct 26 '17	Nov 9 '17
188	Manufacturing & Supply	90 days	Oct 4 '17	Jan 1 '18
189	**Switchyard**	**350 days**	**Apr 15 '17**	**Mar 30 '18**
190	Receipt & Review of Input	3 days	Apr 15 '17	Apr 17 '17
191	Tender Preparation	15 days	Apr 18 '17	May 2 '17
192	Bid Release & Receipt of Offers	35 days	May 3 '17	Jun 6 '17



Project :Mirpurkhas

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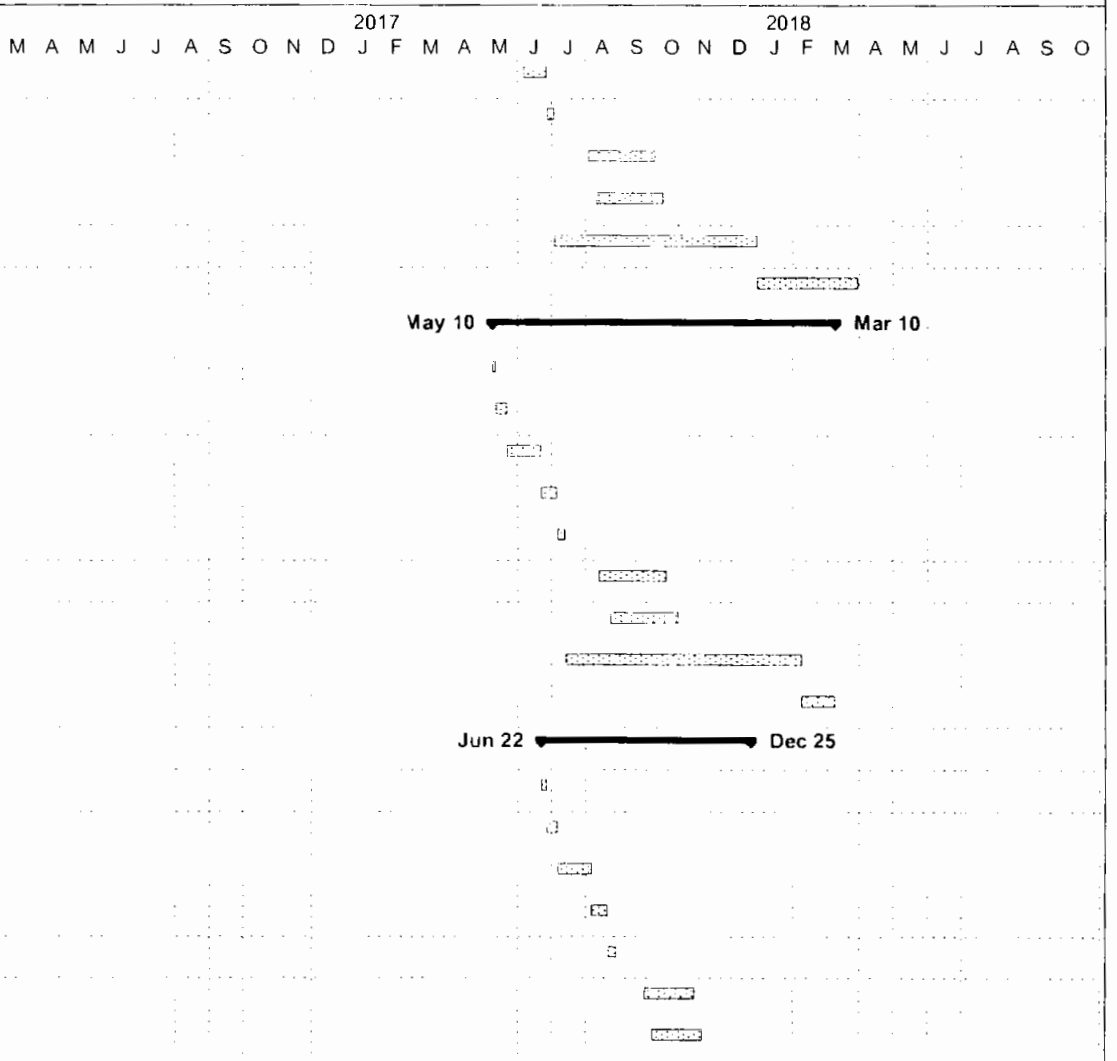
Prepared by S.R.Saipasad | Checked by S.Sivakumar | Approved by S.Balasubramanian

ID	Task Name	Duration	Start	Finish
193	Review, Clarification & Evaluation	20 days	Jun 7 '17	Jun 26 '17
194	Ordering of Switchyard	7 days	Jun 27 '17	Jul 3 '17
195	Submission of Engineering Documents	60 days	Aug 3 '17	Oct 1 '17
196	Review and Approval of Documents	60 days	Aug 10 '17	Oct 8 '17
197	Manufacturing & Supply	180 days	Jul 4 '17	Dec 30 '17
198	Erection & Commissioning	90 days	Dec 31 '17	Mar 30 '18
199	**Transformers**	**305 days**	**May 10 '17**	**Mar 10 '18**
200	Receipt & Review of Input	3 days	May 10 '17	May 12 '17
201	Tender Preparation	10 days	May 13 '17	May 22 '17
202	Bid Release & Receipt of Offers	30 days	May 23 '17	Jun 21 '17
203	Review, Clarification & Evaluation	15 days	Jun 22 '17	Jul 6 '17
204	Ordering of Transformers	7 days	Jul 7 '17	Jul 13 '17
205	Submission of Engineering Documents	60 days	Aug 13 '17	Oct 11 '17
206	Review and Approval of Documents	60 days	Aug 23 '17	Oct 21 '17
207	Manufacturing & Supply	210 days	Jul 14 '17	Feb 8 '18
208	Erection	30 days	Feb 9 '18	Mar 10 '18
209	**LT Panels**	**187 days**	**Jun 22 '17**	**Dec 25 '17**
210	Receipt & Review of Input	5 days	Jun 22 '17	Jun 26 '17
211	Tender Preparation	10 days	Jun 27 '17	Jul 6 '17
212	Bid Release & Receipt of Offers	30 days	Jul 7 '17	Aug 5 '17
213	Review, Clarification & Evaluation	15 days	Aug 6 '17	Aug 20 '17
214	Ordering of LT Panels	7 days	Aug 21 '17	Aug 27 '17
215	Submission of Engineering Documents	45 days	Sep 22 '17	Nov 5 '17
216	Review and Approval of Documents	45 days	Sep 29 '17	Nov 12 '17



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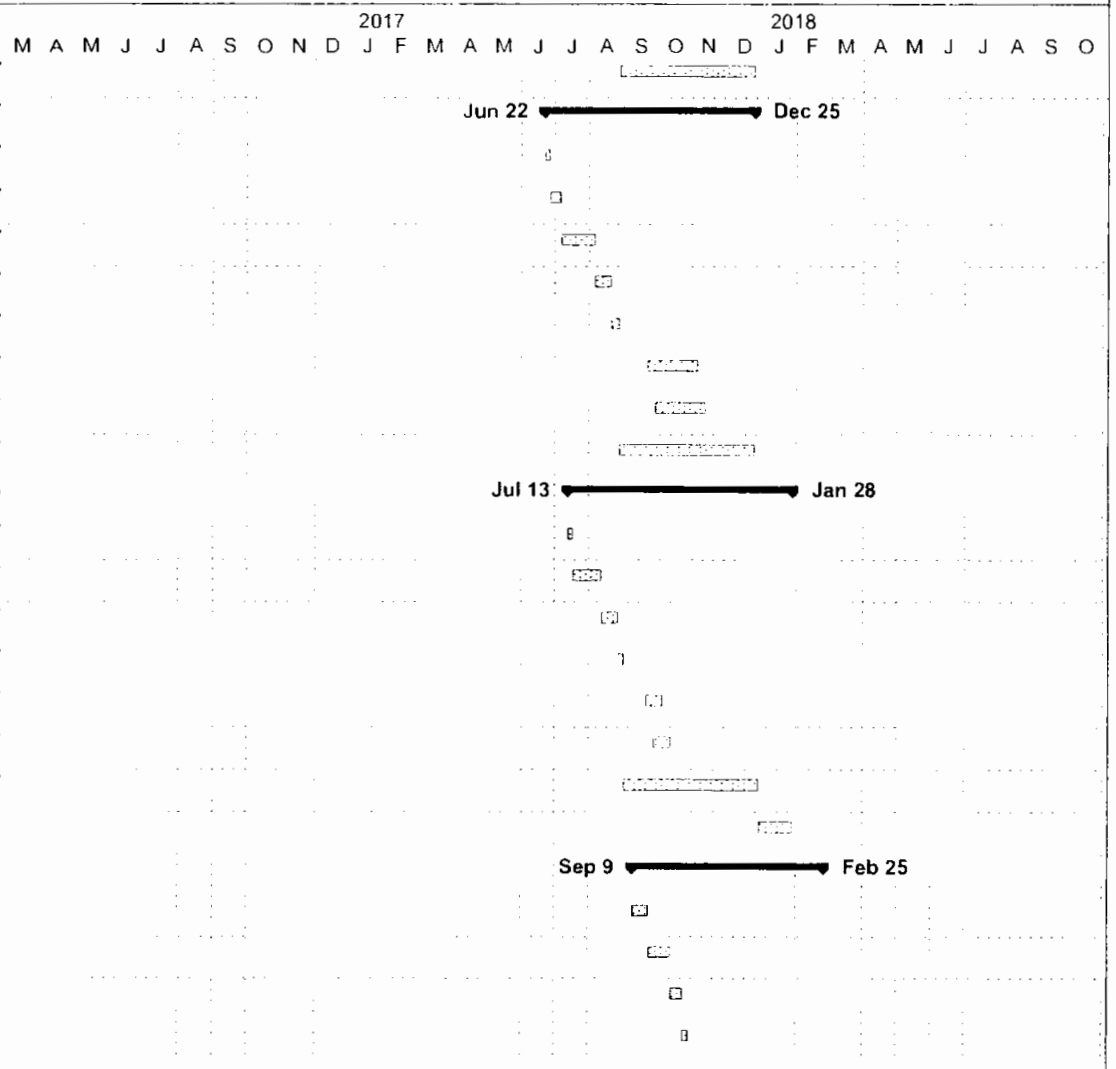
ID	Task Name	Duration	Start	Finish
217	Manufacturing & Supply	120 days	Aug 28 '17	Dec 25 '17
218	**VFD Panels**	**187 days**	**Jun 22 '17**	**Dec 25 '17**
219	Receipt & Review of Input	5 days	Jun 22 '17	Jun 26 '17
220	Tender Preparation	10 days	Jun 27 '17	Jul 6 '17
221	Bid Release & Receipt of Offers	30 days	Jul 7 '17	Aug 5 '17
222	Review, Clarification & Evaluation	15 days	Aug 6 '17	Aug 20 '17
223	Ordering of VFD Panels	7 days	Aug 21 '17	Aug 27 '17
224	Submission of Engineering Documents	45 days	Sep 22 '17	Nov 5 '17
225	Review and Approval of Documents	45 days	Sep 29 '17	Nov 12 '17
226	Manufacturing & Supply	120 days	Aug 28 '17	Dec 25 '17
227	**DG Set**	**200 days**	**Jul 13 '17**	**Jan 28 '18**
228	Tender Preparation	5 days	Jul 13 '17	Jul 17 '17
229	Bid Release & Receipt of Offers	25 days	Jul 18 '17	Aug 11 '17
230	Review, Clarification & Evaluation	15 days	Aug 12 '17	Aug 26 '17
231	Ordering of DG Set	5 days	Aug 27 '17	Aug 31 '17
232	Submission of Engineering Documents	15 days	Sep 21 '17	Oct 5 '17
233	Review and Approval of Documents	15 days	Sep 28 '17	Oct 12 '17
234	Manufacturing & Supply	120 days	Sep 1 '17	Dec 29 '17
235	Erection & Commissioning	30 days	Dec 30 '17	Jan 28 '18
236	**Cables**	**170 days**	**Sep 9 '17**	**Feb 25 '18**
237	Tender Preparation	15 days	Sep 9 '17	Sep 23 '17
238	Bid Release & Receipt of Offers	20 days	Sep 24 '17	Oct 13 '17
239	Review, Clarification & Evaluation	10 days	Oct 14 '17	Oct 23 '17
240	Ordering of Cables	5 days	Oct 24 '17	Oct 28 '17



Project :Mirpurkhas

Task
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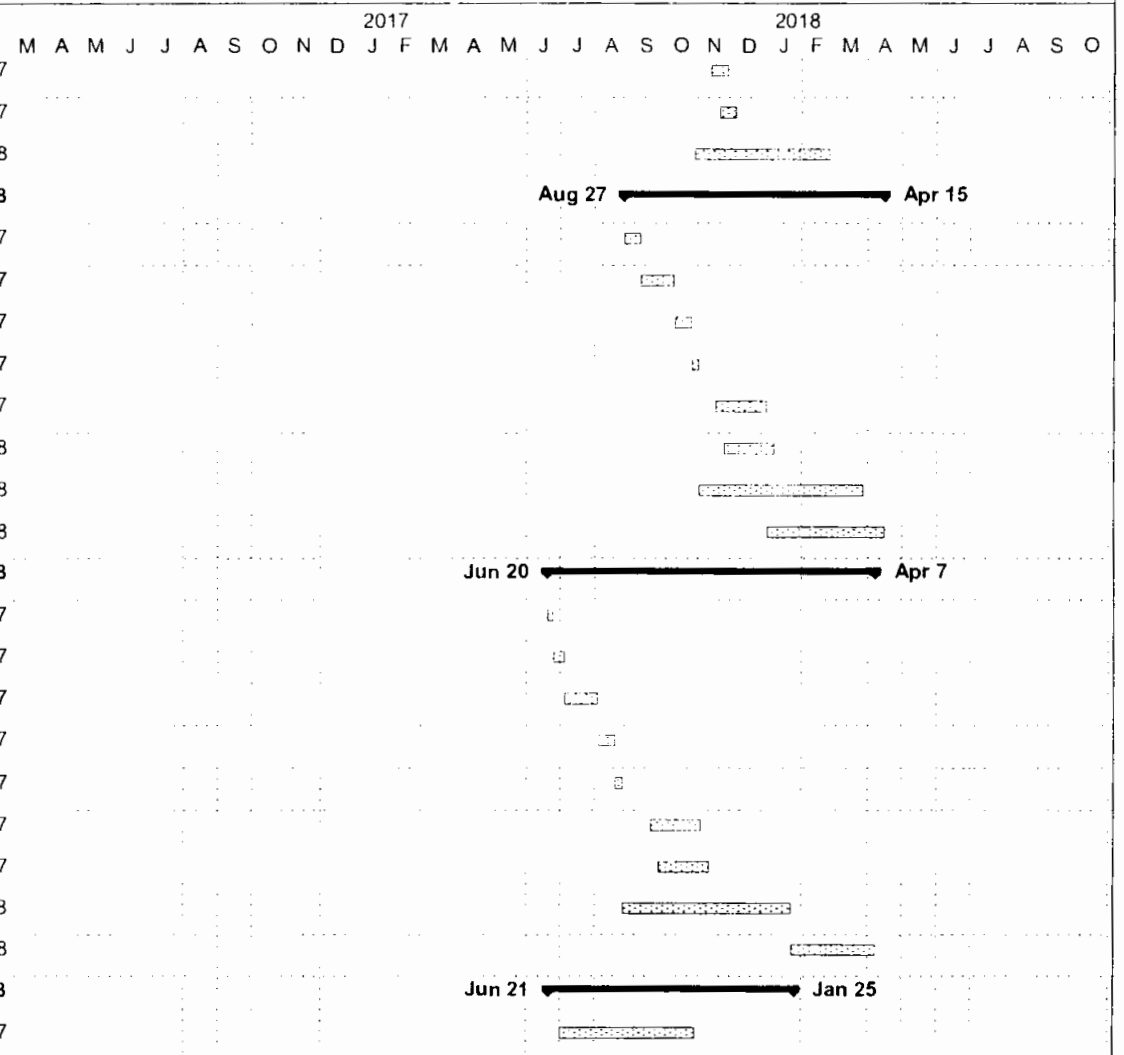
Prepared by
S R.Saipasad

Checked by
S.Sivakumar

Approved by
S.Balasubramanian

ID	Task Name	Duration	Start	Finish
241	Submission of Engineering Documents	15 days	Nov 13 '17	Nov 27 '17
242	Review and Approval of Documents	15 days	Nov 20 '17	Dec 4 '17
243	Manufacturing & Supply	120 days	Oct 29 '17	Feb 25 '18
244	**Electrical Installation Package**	**232 days**	**Aug 27 '17**	**Apr 15 '18**
245	Tender Preparation	15 days	Aug 27 '17	Sep 10 '17
246	Bid Release & Receipt of Offers	30 days	Sep 11 '17	Oct 10 '17
247	Review, Clarification & Evaluation	15 days	Oct 11 '17	Oct 25 '17
248	Ordering of LT Contract Package	7 days	Oct 26 '17	Nov 1 '17
249	Submission of Engineering Documents	45 days	Nov 17 '17	Dec 31 '17
250	Review and Approval of Documents	45 days	Nov 24 '17	Jan 7 '18
251	Manufacturing & Supply	146 days	Nov 2 '17	Mar 27 '18
252	Erection & Commissioning	105 days	Jan 1 '18	Apr 15 '18
253	**Control and Instrumentation Package**	**292 days**	**Jun 20 '17**	**Apr 7 '18**
254	Receipt & Review of Input	5 days	Jun 20 '17	Jun 24 '17
255	Tender Preparation	10 days	Jun 25 '17	Jul 4 '17
256	Bid Release & Receipt of Offers	30 days	Jul 5 '17	Aug 3 '17
257	Review, Clarification & Evaluation	15 days	Aug 4 '17	Aug 18 '17
258	Ordering of C&I Package	7 days	Aug 19 '17	Aug 25 '17
259	Submission of Engineering Documents	45 days	Sep 20 '17	Nov 3 '17
260	Review and Approval of Documents	45 days	Sep 27 '17	Nov 10 '17
261	Manufacturing & Supply	150 days	Aug 26 '17	Jan 22 '18
262	Erection & Commissioning	75 days	Jan 23 '18	Apr 7 '18
263	**Civil-Detail Engineering (By civil consultant)**	**219 days**	**Jun 21 '17**	**Jan 25 '18**
264	Boiler & Auxiliary foundations	120 days	Jul 1 '17	Oct 28 '17



Project :Mirpurkhas

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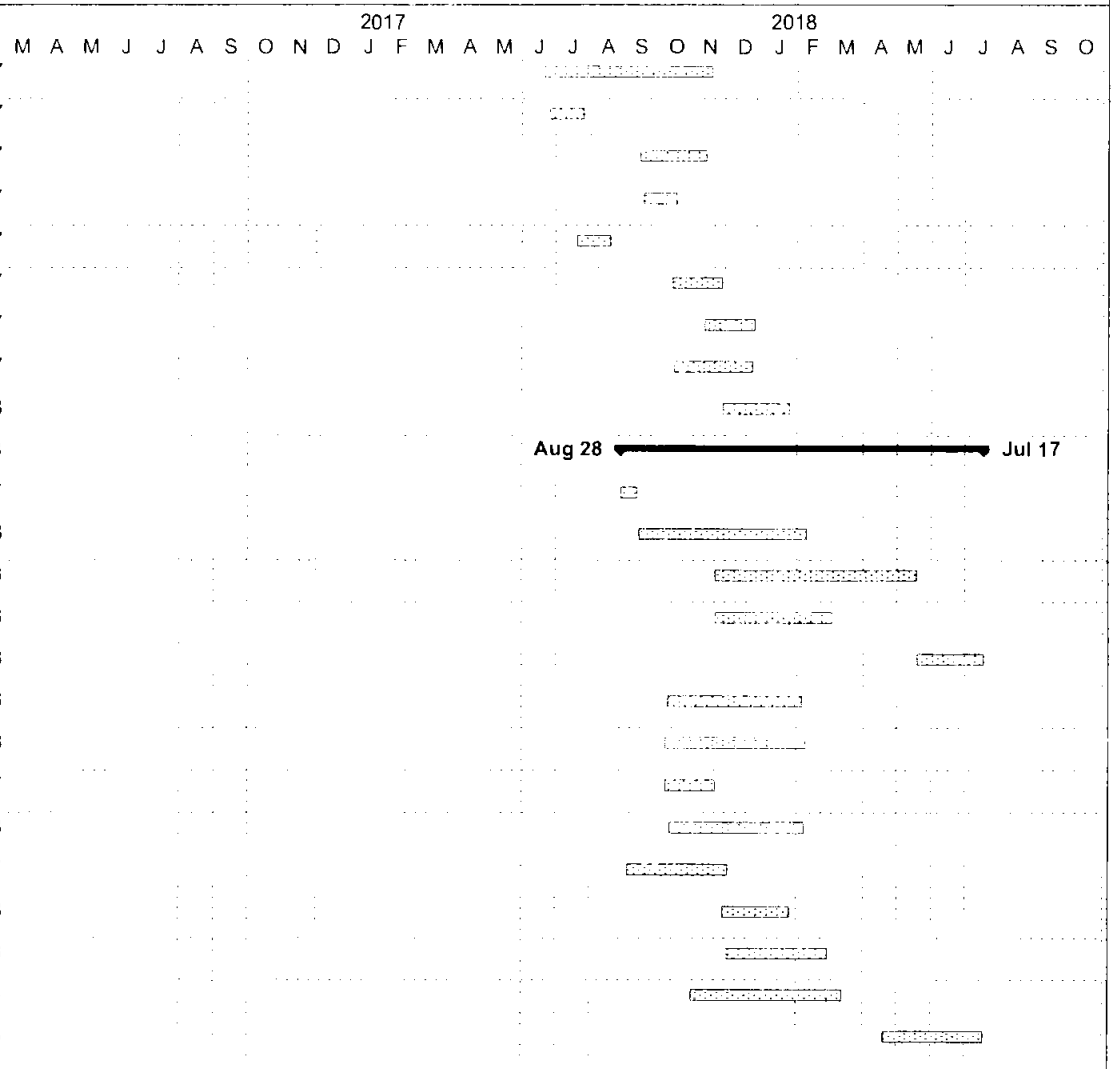
Prepared by S.R.Saipasad
Checked by S.Sivakumar
Approved by S.Balasubramanian

ID	Task Name	Duration	Start	Finish
265	TG Building & Foundations	150 days	Jun 21 '17	Nov 17 '17
266	TG Deck	30 days	Jun 26 '17	Jul 25 '17
267	Water Treatment Plant	60 days	Sep 14 '17	Nov 12 '17
268	Dense Phase System	30 days	Sep 17 '17	Oct 16 '17
269	Tanks foundations	30 days	Jul 20 '17	Aug 18 '17
270	Pump foundations	45 days	Oct 13 '17	Nov 26 '17
271	Transformer & Switchyard foundation	45 days	Nov 11 '17	Dec 25 '17
272	Pipe & Cable Rack & Trench	70 days	Oct 15 '17	Dec 23 '17
273	Miscellaneous foundations	60 days	Nov 27 '17	Jan 25 '18
274	**Civil Construction (by civil contractor)**	**324 days**	**Aug 28 '17**	**Jul 17 '18**
275	Civil Contractor Mobilization	15 days	Aug 28 '17	Sep 11 '17
276	Boiler & Auxiliary foundations	150 days	Sep 13 '17	Feb 9 '18
277	TG Building up to EOT Crane	180 days	Nov 20 '17	May 18 '18
278	TG Deck	105 days	Nov 20 '17	Mar 4 '18
279	TG Building Roof & Completion	60 days	May 19 '18	Jul 17 '18
280	Water Treatment Plant	120 days	Oct 9 '17	Feb 5 '18
281	Fuel Handling System	125 days	Oct 7 '17	Feb 8 '18
282	Dense Phase System	45 days	Oct 7 '17	Nov 20 '17
283	Cooling Tower	120 days	Oct 11 '17	Feb 7 '18
284	Tanks foundations	90 days	Sep 3 '17	Dec 1 '17
285	Pump foundations	60 days	Nov 27 '17	Jan 25 '18
286	Transformer & Switchyard foundation	90 days	Dec 1 '17	Feb 28 '18
287	Pipe & Cable Rack & Trench	135 days	Oct 30 '17	Mar 13 '18
288	Miscellaneous foundations	90 days	Apr 19 '18	Jul 17 '18

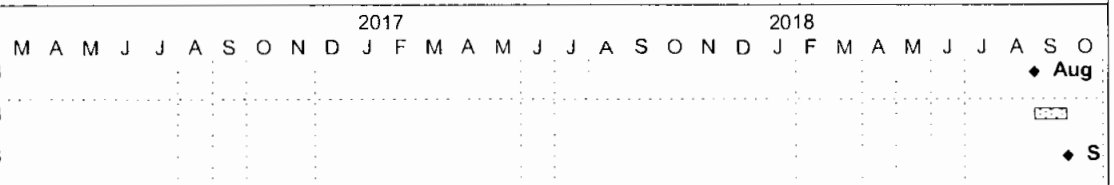


Project :Mirpurkhas

Task — Milestone — Project Summary
Progress — Summary

Prepared by S.R.Saipasad | Checked by S.Sivakumar | Approved by S.Balasubramanian

ID	Task Name	Duration	Start	Finish
289	**Plant Synchronization**	**0 days**	**Aug 31 '18**	**Aug 31 '18**
290	**Trial Operation & Testing**	**29 days**	**Sep 1 '18**	**Sep 29 '18**
291	**COD**	**0 days**	**Sep 30 '18**	**Sep 30 '18**



Project :Mirpurkhas

Task
Progress
Milestone
Summary
Project Summary

Prepared by S.R.Saipasad
Checked by S.Sivakumar
Approved by S.Balasubramanian

ESSA (Environmental and Social Soundness Assessment)

GOVERNMENT OF THE PUNJAB
ENVIRONMENTAL PROTECTION AGENCY
National Hockey Stadium, Gate No. 10
Ferozepur Road, Lahore

NO. DD (EIA)/EPA/F-222(IEE)/2110/2016/05
Dated: 03/01/2017

To

Mr. Yousaf Anis Ahmed,
Director,
M/s Sheikhoo Sugar Mills,
Heaf Office: F-11, Phase-I, Commercial Area DHA,
Lahore Cantt.

Subject: **DECISION OF EPA PUNJAB FOR THE PROJECT "INSTALLATION OF 30 MW BAGASSE FIRED POWER PLANT AT SHEIKHOO SUGAR MILLS LIMITED, TEHSIL KOT ADDU DISTRICT MUZAFFARGARH"**

1. Description of Project: Installation of 30 MW Bagasse Fired Power Plant.
2. Location of Project: Sheikhoo Sugar Mills, Kot Addu District Muzaffargarh.
3. Date of filing of EIA: 15.04.2015

4. EPA Punjab has reviewed the Initial Environmental Examination Report (IEE) and considered Site Inspection Report received from District Officer (Environment), Muzaffargarh vide letter No. 170/16/DOE/MZG dated 10.05.2016. EPA Punjab has also considered the recommendations of **Committee of Experts** (Meeting dated 07.09.2016), recommendations of **EA Committee** (Meeting dated 21.10.2016) and other relevant record.

5. **Environmental Protection Agency, Punjab accords approval for the aforesaid project subject to the following conditions:**

i. The proponent shall install new and state of the art systems, machinery, equipment, instruments that are most efficient and latest in their development cycles.
ii. The proponent shall comply with the Punjab Environmental Quality Standards (PEQS) by installing appropriate pollution control equipment and/or treatment plants where necessary.
iii. Mitigation measures suggested in the Environmental Management and Monitoring Plan (EMMP) of the IEE shall be strictly adhered to. The proponent shall detail expert(s) to monitor, ensure, and report compliance of the EMMP.
iv. Monitoring shall be carried out during the entire period of the project activities. Monitoring reports of the whole operation shall be submitted to EPA, DOE on quarterly basis.
v. The proponent shall install online air pollution monitoring analyzers for regulated pollutants like particulate matter, CO and provide EPA Punjab continuous online access to these analyzers. Additionally the proponent shall also provide a mobile ambient air quality monitoring station for monitoring of SPM due to the project at points of peak concentrations on the ground in the vicinity of the project.
vi. The proponent shall install wastewater treatment plant and shall dispose of the treated wastewater in compliance with PEQS and submit the relevant NOC for discharge of disposal of waste
vii. The proponent shall take all necessary measures for disposal of fly ash & bottom ash in a scientific manners.
viii. The proponent shall ensure that strict and efficient health and safety measures are in place for protection of the workers in case of any environmental emergency and these measures are backed by a comprehensive emergency response system.
ix. The proponent shall take measures for storage of fuel as per the governing law.
x. This environmental approval for the project does not absolve the proponent of the responsibility of obtaining necessary permissions from any other concerned authority which may be required under the law.

P.T.O

xi. The project-affected people, if any, shall be compensated as per the governing law of the land.

xii. The proponent shall install state of the art and latest in development cycle machinery.

xiii. The proponent to submit all the documents, drawings / designs before operational phase.

xiv. Any change in capacity or any other characteristics of the project, the proponent shall seek prior approval of EPA Punjab.

xv. The proponent shall obtain NOC / clearance from all other concerned departments before commencement of work.

xvi. The proponent shall provide proper fire-fighting arrangements.

xvii. The proponent shall follow the SOPs regarding dengue larvae eradication and shall ensure removal of stagnant water on daily basis.

xviii. The proponent shall install ambient air quality monitoring station and provide online access to the EPA Punjab through GSM technology. The proponent shall dispose off fly ash in scientific manner.

xix. The proponent shall appoint Environmental Manager for the project and shall convey his name along with his complete Mailing Address and Phone Numbers.

xx. The proponent shall submit undertaking the no interim injunction has been issued by any court of law of the country against the said project as of date of issuance and receiving of this approval and in case of any such injunction, this approval shall stand cancelled.

5. The proponent shall be liable for correctness, exhaustiveness and validity of information supplied to this department by the environmental consultant.

6. The proponent shall be liable for compliance of Regulations 13, 14, 18 and 19 of IEE/EIA Regulations, 2000, regarding approval, confirmation of compliance, entry, inspections and monitoring.

7. This approval is accorded only for the construction phase of the project. The proponent shall apply for confirmation of compliance under Regulation 14 of IEE / EIA Regulation, 2000 by submitting Environmental Management Plan for operational phase along with compliance status report of the Environmental Approval of the construction phase of the project.

8. Any change in the approved project shall be communicated to EPA, Punjab and shall be commenced after obtaining the approval.

9. This approval shall be treated as null and void if all or any of the conditions mentioned above, is/are not complied with. This approval does not absolve the proponent of the duty to obtain any other approval or consent that may be required under any law in force and is subjudice to legal proceedings in any legal fora / court.

10. This approval shall be valid (for commencement of construction) for a period of three years from the date of issue under Regulation 17 of IEE / EIA Regulations, 2000.

11. This approval can be withdrawn at anytime without any prior notice if deem necessary in the public / national interest.

ASSISTANT DIRECTOR (EIA)
for Director General, EPA, Punjab
Ph: # 042-99232282

NO. & DATE EVEN.

A copy is forwarded for information to:

The District Officer (Environment), Muzaffargarh w.r.t. his letter No. 170/16/DOE/MZG dated 10.05.2016. He is requested to ensure compliance of the above mentioned conditions / measures under intimation to this office.

ASSISTANT DIRECTOR (EIA)
for Director General, EPA, Punjab
Ph: # 042-99232282

CHAPTER 6

SOCIAL AND ENVIRONMENTAL IMPACTS

The installation of 30 Mega Watt (MW) bagasse fired thermal power plant involves excavation, construction activity, erection of the parts of plant and allied machinery at proposed site.Bagasse firing has mainly impact in the form of particulate matter emission and this power plant project is small in size and magnitude and hence no significant environmental impacts are fore seen. However, the bagasse handling and ash disposal have significant impact on the environment which needs to be mitigated through proper control measures. The social impacts of the plant issue like resettlement or compensation are not significant because the land is already purchased by the owner and no population or settlement exist there. The impact of handling activities, bagasse burning, ash disposal are significant where as green house gases emission are positive. The social and environmental impacts are discussed in this chapter.

6.1 SOCIAL CONSIDERATIONS FOR BIOMASS POWER PLANT

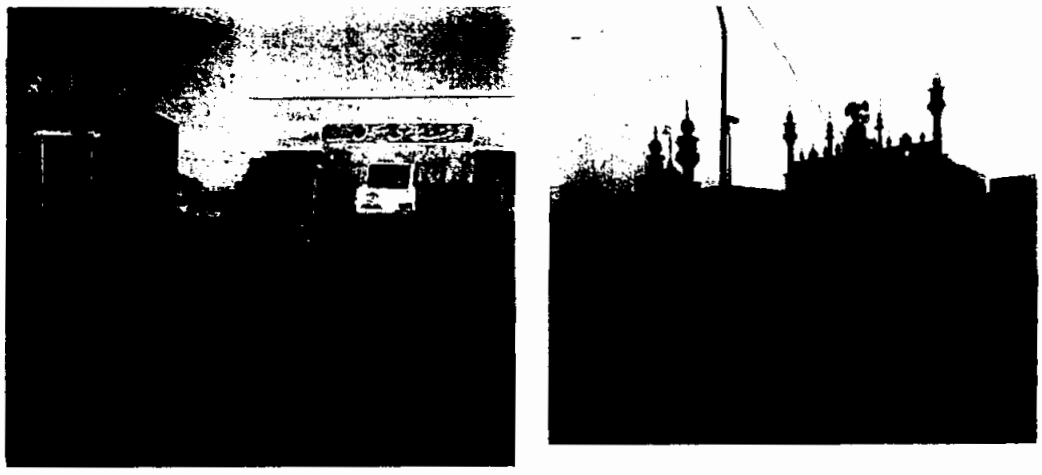
The area is low income group and hence positive social indicators are expected at locally as well as national level. The reduction in load shedding is predicted due to generation of electricity which is lacking in our country and is a contribution towards improving the quality of living. The electricity generated from this plant will also be helpful for units which are struggling against the electricity load shedding. It will boost up the sluggish growth rate of national economy. By considering the characteristics of environmental and social aspect in the area of Sanawan and project components of Thermal power plant, the following environmental and social impacts are predicted during construction and operation stages.

6.2 SOCIAL IMPACTS

The existing status of the land for the project was low producing agriculture. No issue of resettlement is involved. Bagasse from the nearest sugar mills Sheikhu sugar Mills will be procured for this project.

[illegible] will have [illegible] impact in the area. Local people will get employment opportunities. Daily use items like vegetables, meat, milk, bakery , grocery and services like washing, barber , transport, cooking and services will be procured from local market which will have overall positive social impact in the area. New stalls and small shops are likely to be established there making the value of the area more positive.

Increase of land prices in the vicinity of plant is forseen after its operation which is another positive outcome of the project. The area is thinly populated and safety conditions on approach road are not good. After execution of work on site it will be improved considerably.



PP 6.1: Social Buildings in the area

The proposed plant therefore, has no anticipated negative social impact during construction and operation phase. However, some stake holders and residents of the area demanded that employment may be preferred to the local people. The people include farmers, labors, workers of industry public representatives and some officials. The area is dominantly agriculture in nature where trend of industrialization will be seen after this project. Thae Sheikhu sugar mills is already working there . This project will trigger the pace of industrialization in the area.The project area also has fields of sugarcane, vegetables, rice fodder, and wheat. Shops of different business and services are expected during construction and operation phase.

PP6.2: Two important sources of income ; agriculture and live stock

6.3 Living and Livelihood during Construction Stage

The people of the area depend upon agriculture, labour, service in factories and the city of MuzaffarGarh and Kot addu. Some of them rely upon the business in near towns.

During construction stage of the projects machinery of medium size and construction equipment will be employed. No road traffics blockage is seen as the site is located adjacent to Sheikhu sugar mills and well away from any city.

This activity will cause no significant negative impacts on living and livelihood of the people around the project site after redesigning of the road. **Table-6.1** shows initial assessment of possible social impacts.

Table-6.1 Initial Assessment of Possible Social Impacts and solution

Issue	Possible Impact		Counter measures	Impact after countermeasures
	Construction	operation		
Land use	Positive	Positive	Not needed	Positive
Population and housing	Not significant	Not significant	The labour will be camped within the factory and boundary wall of	Positive

infrastructure capacity	Not significant	Not significant	Shakot road can accommodate the additional trucks during construction and operation phase	Significant
Employment	Positive	Positive	Not needed	Positive
Transportation	Slightly negative	Positive after improvement of road	Shakot road needs improvement	Positive
Archaeological and social resources	Not significant	Not significant	Not needed	Not significant
Resettlement	Not required	Not required	-	Not significant
Living and livelihood	Not Significant	Positive	Local people may be preffered	**Significant positive**
Individual income	Positive	positive	Not needed	Positive
Increases tax base	Positive	positive	-	Positive
Cheaper electricity	-	positive	-	Positive
Decrease in load shedding	Positive	positive	-	Positive
Aesthetic	Slightly significant	positive	The construction phase is for short period. After completion it will add to scenic beauty of area.	Positive
Malaria and dengue	Significant	significant	The plant area will be kept clean and dry. Pond	Less significant after

Change in community	Significa...	Not significant	The labour will live within during construction and operation phase. They will live separately and no cultural issue will be there.	Not significant
Change in religious or ethnic make up	Not significant	Not significant	Not required	Not significant
Change in crime rate	Significantly positive	positive	The incidents of robbery on Sanawan road will be decreased with this project	Positive
Public health	Slightly significant due to mosquito.	Not Significant	Transmission will be kept away from villages	Not significant

6.4 Conclusion and recommendation:

The construction and operation phase of the project has positive impacts on the economy and social set up of the area through reduction in load shedding, decrease in electricity price, increased income, better employment chances, improved infrastructure, increase in land value and decrease in theft incidences. Spriklind of water and cleanliness of the plant and ash disposal site is necessary to keep the mosquitoes away.

6.5 ENVIRONMENTAL IMPACTS

Bagasse is the eco-friendly alternate fuel which has less harmful effects as compared to coal and fuel oil. The ever increasing concerns on climate change has forced the technologists of focus on the alternate fuels to curb the CO_2 emission. Sugarr bagasse gives reasonable good heat value as well as less gaseous emissions in the atmosphere. Moreover, the travelling grate is also environment

6.5.1 Approach for Assessment Methodology

Sheikhu Power pvt limited feels bindings to the environmental laws and regulations and hence adopting the best technology for this power project which conserve the environment. It emphasis the compliance of all NEQS (standards) notified so far mentioned in chapter 2. The process of the power plant, its design, flow diagram and mass flows are studied to and compared with national environmental Quality standards to assess the possible environmental impact. As the proposed plant will discharge significant amount of PM, ash and waste water, the impact on the environment have been analyzed keeping in the quantity of pollutants in the waste stream. Impacts of construction and operation of 30 MW bagasse fired thermal power plant are necessary to be assessed and mitigated on living environment.

Exceedng NEQS= Highly Significant (HS)

NEQS= Moderately significant MS)

Below NEQS= Not significant (NS)

6.5.2 Preconstruction and Construction Stage

Camp Management

6.5.2.1 Air Quality

The proposed site of the plant is agricultural and have clean air during the study period. The site is adjacent to the Sheikhu Sugar Mills, therefore, the activity of construction may have negative impact during the cane crushing season where sugarcane trolleys contribute a significant amount of fugitive dust to raise the dust in the local area. It is therefore, suggested that the construction of the propsed paint may be carried out in off season to keep the people from dust problem. Exhaust of trucks which will bring building material, plant assembly and foundation building process be source of air pollution at construction stage. It is also expected that particulate matter will be produced in limited level due to construction activities thus leading to fugitive dust emission. Sprinkling of water at regular intervals on all loose

during construction phase, mechanical activities during construction the soil removed, will be transported to the designate place at the same time to avoid dust dispersion in the air. Meanwhile speed of trucks will be controlled reduce the dust emission.

After construction of plant loose soil will be removed or covered with vegetation to avoid particulate dispersion into air. The nearest residence near the project site is in form of clusters e.g. Patti Naich is about 1 Km therefore, least impact is foreseen on nearby population in case the air moves to this direction. The prevalent wind direction is seen from south west side while the the village is on opposite side of the plant. Therefore, during construction the dust will have low significant effect which will be mitigated through regular water showering. And fixing the speed limit of trucks.

Additional trucks will pass on the road which may impact adversely the local atmosphere. It will be mitigated through implementation of NEQS limits for exhausts of trucks.

Air pollution during both stages are reduced by labour/driver education, periodic vehicle maintenance, keeping within the speed limit, working time controls and periodic water spray to dusty soils.

6.5.2.2 Noise Level(LS)

At pre-construction stage, the spot noise levels measured at the site vary 50-52 dB(A). However during construction phase, these are expected to increase only during construction stage resulting from the activities of different construction machines, transportation vehicles, excavators and dumping trucks etc. No sensitive receptor is located near the site.However, horns of the trucks may pose disturbance to local people. Therefore, the trucks with pressure horns will not be allowed at site. The contractor will be made bindings not to use the trucks of pressure horn. Therefore, after mitigation measures to hence construction activity will have insignificant impact regarding noise pollution.

following reasons:

- The site is located at where no regular village is located.
- There are no sensitive receptors like hospitals, libraries, or school near the site.
- The nearest population is about 1 Km away from the project site where noise will be dispersed before reaching the village.
- This temporary noise level would be short term and confined to site only.

6.5.2.3 Soil Removal and Soil Erosion (LS)

This is a small sized power project. The soil will be removed only during foundation work on limited level which will be filled by concrete or bricks. The loose soil produced will be leveled in the plant premises as it needs the uplifting of plinth level. Therefore, soil erosion will not be caused. The storm water of plant will be collected into a large pond hence no soil erosion is expected during construction stage. The area is devoid of any forest or trees cover, therefore, construction activity will not add to the runoff activity. The construction of plant and its structure at this site will reduce the run off.

6.5.2.4 Drainage and Surface Water Changes (LS)

No canal is passing by the proposed site. A water logging drain known as Rohi or sem drain passes at distance of 1Km from plant boundary. No water will be disposed in it during construction phase and no impact is foreseen during construction of the project. The storm water will be collected into a large pond which will reduce the magnitude of splash floods in the area.

PP 6.4: The drain which will receive surplus treated municipal waste water

stage and drainage pattern. It is followed by [illegible] biological treatment. Quantity of the expected out flow of the municipal waste during construction phase will be 0.0176 cusec. (on the basis of assumption that waste water is discharged @ 7 LCD. The treated wastewill be disposed in Pohi. The drain may have eutrophication effect due to higher NO3 and PO4 in it. It will result in more growth of chara and other algal species into drain which may retard the flow rate. After completion of the construction the drain will be cleaned to mitigate the eutrophication impact.

Because it will be limited to construction phase and hence has low significant impact after mitigation measure proposed above. (LS)

6.5.2.5 Ground Water

During construction stage underground water will be used for construction purpose. Water required for Construction stage will be drilled out from the subsoil water. The geotechnical study is underway for this site but keeping in view the existing tube wells on the site it is safe to say that the water table of the site is up to 50 feet. The pumping of subsoil water for construction phase will not lower the water table due to recharge mechanism of river Chenab and indus.

6.5.2.6 Wildlife (endangered and threatened species) (NS)

No wildlife exists at the site. The area is agricultural where people have live stocks. Therefore no wild life is disturbed during construction phase. No endangered species was seen on the project area. However some trees of Shisham (Delbergia sissoo) are threatened species which should be avoided during construction phase. After construction is complete Delbergia sissoo will also be planted in and around the plant along with other native species.

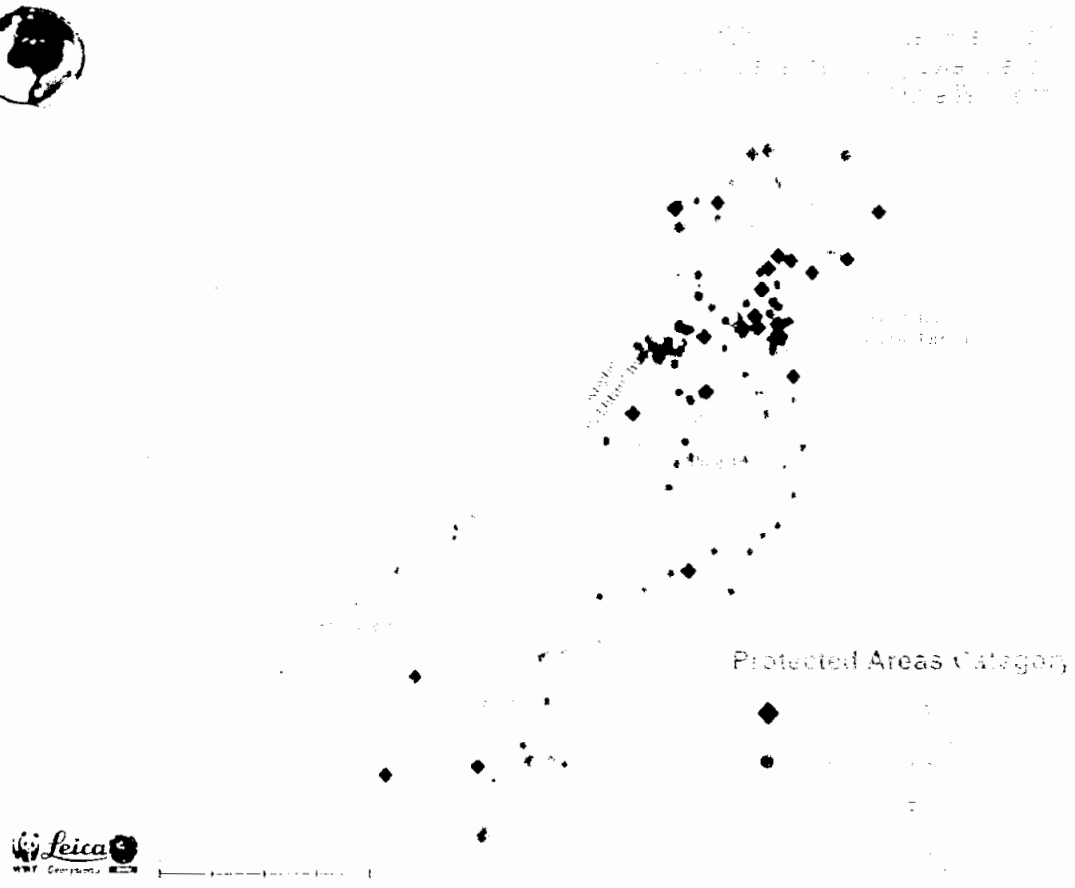


Figure 6.1: Protected areas of Pakistan

6.5.2.7 Secondary Development (B)

The construction period will have a significant impact on the villages around the project site. Opportunities for commercial activities are foreseen at limited level in this location. Canteen, tire shop, auto workshop, tea stall, utility shop and hotel are expected. Another positive secondary development will be increase in job opportunities for the locals at the plant during construction in particular and its allied services in general. Employing as many locals as possible can moderate the arrival of large outsiders' work force. This will reduce the need for outside workers and outside worker housing. One sugar mills is already present in area where business of local people is carried out. The mills has already attracted people from other villages as well as other cities for industrial manpower. Construction phase will create job opportunities directly or indirectly. Limited number of people are expected to come from outside during this phase and camps for small labour will be within the plant boundary therefore no change in social set up is foreseen.

Hence the secondary development due to this plant is foreseen as positive impact.

6.5.2.8 Relocation of any Existing Structure

The present site is agriculture and has no residence thereof so no relocation is involved. No relocation of structures is foreseen.

6.5.2.9 Land Use Changes (B)

The proposed site is agricultural and after construction of the plant there will be shift in land use. This shift in land use will produce more finances than the agriculture. During the survey it was determined that the present income of the people from this land is about 1-3 lac per acre per annum depending upon the fertility of the soil, water availability and market rate of their produce. The land use change generates much more production in terms of MWh and its value (Rs 2.5 million). Government will also earn taxes from this generation. This land use change is seen positive.

Another important factor is the increase in land price. With the commencement of construction more investors will be attracted to this area which is neglected so far. Hence the price the land will increase in the area.

The land use change will reduce the scenic value when compared with the fields of rice and wheat. Some people say industrial structure will make the area more aesthetic as compared to present scene. The outlook of the plant building should be green in color so that it may be comparable with back ground color. More fruit and ornamental plants will be planted during operation phase to nullify the negative impact on aesthetics due to shift from agriculture to industrial one.

Hence change in the designated use of land is anticipated to produce positive impacts on economy on the area as well as on national level. (**Beneficial**)

6.5.2.10 Traffic (Medium Adverse, MA)

The Kot Addu road is to be used for transportation of raw materials, equipment, plant machinery and material of construction. The density of traffic on this road is medium which include heavy and light motor vehicles. The PARCO and KAPCO oil terucks pass from this road. Although the volume of traffic on it is up to 100 motor vehicles per hour and its volume has no mark able impact on the existing road gradient level

number of trucks during construction phase. Besides, there are sugarcane fields near the site which has high rush of sugarcane trolleys. Therefore it is recommended that construction this plant may be done during off season to reduce the load of traffic for general public. The villages on sanawan road may have increase safety issues during construction stage. Therefore, proper signboard for drivers and general public may be fixed all along the road to avert any mishap on the road. These signboards should include safety instructions or warnings.

The additional load of few trucks during construction will be mitigated through fixing of traffic and safety signboards.

This temporary increase will even out during the operation stage of the project during which the traffic shall stabilize. The present infrastructure of the Sanawan road will be able to accommodate the temporary increase in the volume of the traffic without causing any traffic hazard. If construction is carried out during th off months of cane crushing season.

Hence its impact will be slightly significant after mitigation measures.

6.5.2.11 Solid and Hazardous waste

Construction sold waste like soil, sand or bricks will be used to fill the lower parts of the site. The kitchen waste from labour camps will be collected in designated bins and finally disposed off at designated land fill of Kot Addu. Presently there is no solid waste collection system in the area . The machinery import will be brought in wood and metal casings and coverings which will be sold to recyclers. The cans of paints or chemicals will be collected in designated covered site and notified properly so that workers should note these are hazardous. These cans will be sent to the licensed hazardous waste disposal facilities approved from EPA. The workers will be provided with personal protective equipment while working with such wastes.

The solid waste generation and its proper disposal as explained above will have insignificant impact on the environment.

6.5.2.12 Fuel and chemical storage and Handling

During construction storage and handling of oils and chemicals (if used) will be properly stored and handled by trained workers. The oils will be stored in designated and covered stores whose floor will be cemented. Trained staff will handle the oils to avoid any spillage of oils or chemicals.

	Physical Environment							Bio-Environment		Socio –Economic Environment						
Environmental component / Project Activities	Topography	Soil Quality	Landscape PC	Surface water Quality	Ground water quality	Air Quality	Noise and Vibration	Flora	Fauna	Agricultural land	Health & Safety	Disruption of public utilities	Employment	Population Disturbance	Social Disorder	Archaeological sites
Construction camps, Workshops etc.	O	LA	O	O	O	O	LA	O	O	O	LA	O	B	O	O	O
Transportation of construction materials	O	O	O	O	O	LA	LA	O	O	O	LA	O	B	O	O	O
Open storage of construction materials, fuels etc.,	O	O	O	LA	LA	O	O	O	O	O	LA	O	O	O	O	O
Storage of chemicals or lubricants	O	LA	O	LA	LA	O	O	O	O	O	LA	O	O	O	O	O
Relocation	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Use of generators	O	LA	LA	LA	LA	LA	LA	O	LA	O	LA	O	O	LA	O	O
Stripping and leveling	LA	LA	LA	O	O	LA	LA	O	O	O	LA	O	O	O	O	O
Secondary development	O	LA	O	O	O	LA	O	O	O	LA	O	O	B	O	O	O
Land use change	O	LA	B	O	O	LA	O	O	O	B	LA	O	B	O	O	O

Legends: O=Negligible/No Impact B=Beneficial LA= Low Adverse MA= Medium Adverse HA= High

6.5.2.13 Conclusion and recommendations (construction phase)

The changes likely to occur during the pre-construction and construction phase of the plant have been discussed above. It is concluded that due to small level power plant, mitigating actions and distant location from cities and towns, there will be least significant impacts on soil, roads wildlife and social setup of the project area. The minor effects will be mitigated through some of the measures already discussed above.The consytuction will be dome during the closure of sugarcane crushing season to avoid transport problems in the area. The construction phase also will affect the area positively with respect to availability of job, services and commodity sale to the workers and machinery at site.

6.6. Operation Stage

This section describes the effect of proposed plant on the environment during its operation stage.

6.6.1 Air pollution

155 tph boiler will need 58.8 tons per hour bagasse during operation which will emit 2.9 tons/ per ohour ash @ 5 percent of ash generation. During on season it will consume 46.68 TPH bagasse and ash generation rate will be 2.33 tons per hour. Operation of thermal power plant on bagass has no significant emission except particulate matter. There is one stack of proposed 60 meter height which will be emitting dust (PM), CO and other gaseous emissions. More over handling of ashr and ash collected from ESP may have dust emission at local level. The emission levels of air pollutants emitting from plant operation and their impact have been calculated as below:

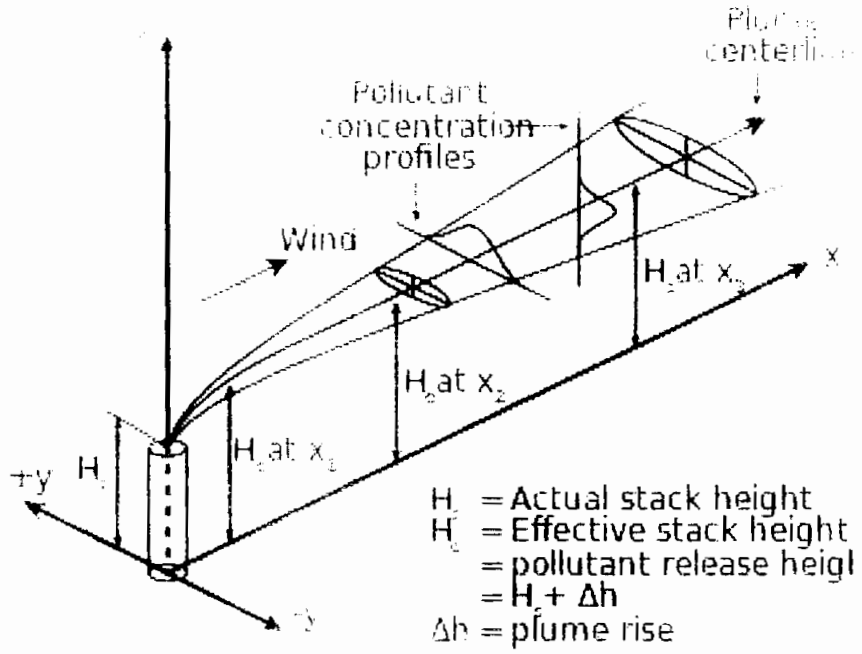


Figure: 6.2 plume dispersion

Table 6.2: Air Quality performance regulation for this Power plant

Air Quality standards

1. **Ambient air quality:**

Parameter	(NEQS)	WHO 2005	World Bank Group (WBG,1998)
SPM	500 µg/ m^3 for 24 hours		Not given
PM_{10}	150 µg/ m^3 for 24 hours		150 µg/ m^3 for 24 hours
SO_x	120 µg/ m^3 for 24 hours	i. 124 µg/ m^3 for 24 hours ii. 500 µg/ m^3 for 10 mint	150 µg/ m^3 for 24 hours

[illegible]	[illegible]	[illegible] µg/m³ for 1 year 200 µg/m³ for 1 hour	[illegible] µg/m³ for 24 hours
CO	5 mg/m³ for 8 hours		-

2. **Stack Emission:**

Parameter	(NEQS)	IFC 2008	World bank group (WBG,1998)
PM for solid fuel boilers	500 mg/ m³	-	50 mg/Nm³
SO_x	i.1700mg/N m³	-	2000mg/Nm3
	ii. 500 t/d/plant		0.2 t/d/MW (35tpd)
	i. 50ug/m3 (annual)		
NO_x	i.300 ng/J of heat in put	-	i. 260 ng/J heat input
	ii. 858 mg/Nm3		ii. 750 mg/Nm3
CO	800 mg/m³	-	Not given

6.6.2 Particulate Matter

Burning of bagasse will have less emissions with respect to coal. Almost 58.8 tons of bagasse per hour will generate 2.99 tons total ash per hour and . Out of this amount 99.9 % will be collected by ESP and the mass emission rate of PM in the flue gases will be 0.0058 tons per day fly ash. After fly ash removal the concentration of Particulate matter in flue gases will be restricted to limitation of 70 mg/Nm3 well below NEQS limts of 500 mg/Nm3 for solid fired boilers. In this way the emissions of PM from the proposed power plant stack will comply the nationalstandards. The air quality standards to be complied by the proposed plant are given in table 6.2:

The flue gases will be emitted at the height of 60 meter from ground level. The emission rate of Particulate matter is estimated @ 0.0058 tons per hour (1.61 gm/sec) with flue gas temperature of about 140 C. The dispersion of these particles will be dependent upon size of the particle, wind speed, stack height, flue gas exit gas temperature, particle exit velocity, ambient temperature, wind speed and meteorological conditions. The data of wind speed, wind direction, and temperature was obtained from Pakistan Meteorological Department for Multan station. The met data was used for determination of ambient air quality with respect to Particulate matter is given in Table 6.3.

The parameters used for conduction of dispersion modeling are given below:

Table 6.3: Results of dispersion modeling for Particulate Matter

Month	Temp. C	Wind speed(m/sec)	Wind direction	Solar radiation	PM emission rate (g/sec)	Stack height	Average at ground level ug/m3
January	Max 18.6 Min 5.11	2.96	N-W	Weak	1.61	60	9 at 1915 m
February	Max 20.88 Min 7.38	3.54	N-W	Weak	1.61	60	10 at 1650 m
March	Max 26.2 Min 11.6	3.54	N-W	Moderate	1.61	60	13 at 1190m
April	Max 31.38 Min 16.77	4.14	N-E-N-W-S	Strong	1.61	60	6 at 1800 m
May	Max 36.88 Min 20.38	4.14	S-W	Strong	1.61	60	5 at 1312 m
June	Max 39.0 Min 23.38	4.14	S-W-S-E	Strong	1.61	60	6 at 1200 meter
July	Max 34.27 Min	4.73	S-E	Strong	1.61	60	6 at 1800 m

	Max 33.2... Min 21.72						
September	Max 33.27 Min 21		S-E	Strong			4 at 3100 m
October	Max 31.11 Min 16.0	3.54	S-W-N	Moderate	1.61	60	6 at 1275 m
November	Max 25.38 Min 10.72	2.36	N-W	Moderate	1.61	60	14 at 1071
December	Max 20.22 Min 6.5	2.36	N-W	Weak	1.61	60	16 at 1220 m

The table above shows that the particulate matter (PM10) at ground level will be 4-16 ug/m3 in the dominant direction South West from the plant. The maximum concentration through the year is determined 16 ug/m3 at the distance of 1220 m during December. It is safely within the limits of NEQS for ambient Air quality. The nearest population is Patinaich (2 KM) which will be safe and impact of bagasse burning in thermal power plant with respect to Particulate matter will be insignificant. The ground level concentration due to operation of the plant will least Adverse (LA) due to mitigation steps and compliant of NEQS, and WHO guidelines.

The dust emission from bagass handling activity in yard will be course in size and will not go outside the plant premises due to boundary and distance. The bagass wil be conveyed through conveyor belt rather than manual system which will reduce the fugitive dust at bagasse handling sytem.

Mitigation measures

- Low moisture content of bagasse will be preferred
- Complete burning/ high efficiency
- Installation of ESP
- Tall stack of 60 meter height
- Maintenance of ESP

Hence the impact regarding PM emission from the proposed bagasse fired thermal power plant is calculated to be insignificant after mitigation measures.

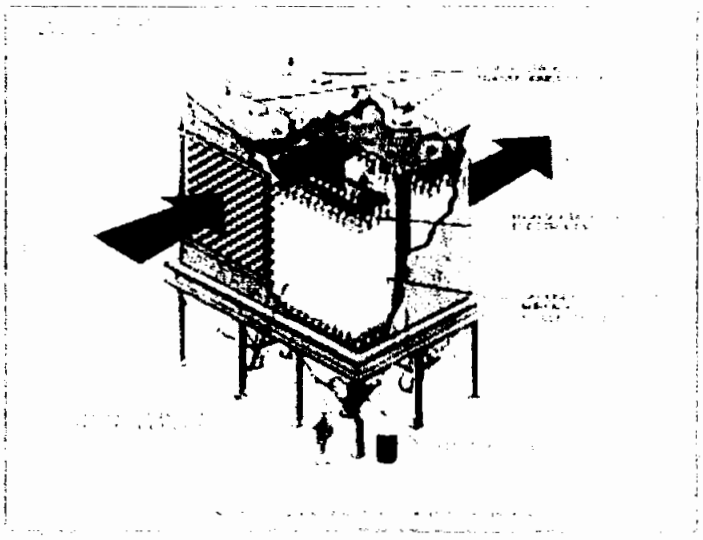


Figure6.4 : Electrostatic Static Precipitator (ESP)

6.6.3 Oxides of Sulfur

Sulfur dioxide emission form bagasse fired power plants is very insignificant. Bagasse has up to 0.04 percent sulfure content If emitted, unabated, it will emit .023 kg per hour or 0.000023 tons per hour of SO2 in the atmosphere through 60 meter high stack. No mitigations are required to control such small concentration which is within NEQS.

Plant has to restrict the SO2 emissions up to 500 tons per day while in this case SO2 emission will be 0.00552 tons per day as compared to the permissible level of 500 tons in NEQS.

6.6.4 NOx (Oxides of Nitrogen)

Proposed thermal power plant will have SCR system to control the NOx generation and limit the emission to 302 Kg/hour NOx as NO2 which comes out to be 510 mg/Nm3. The same emission can be expressed as 198 gm/GJ of heat input. These emissions are within the NEQS value and World Bank Guidelines which cap the NO_2

through adoption of modern grate technology which [illegible] the combustion of [illegible] through phased air supply. The effective catalytic combustion at this temperature allows minimum NOx generation which does not need additional mitigations.

The ground level concentrations from the plant are calculated to the tune of 72 to 90 ug/Nm3 which is below the 100 ug/Nm3 prescribed in NEQS and 150 ug/Nm3 in WBG guidelines.

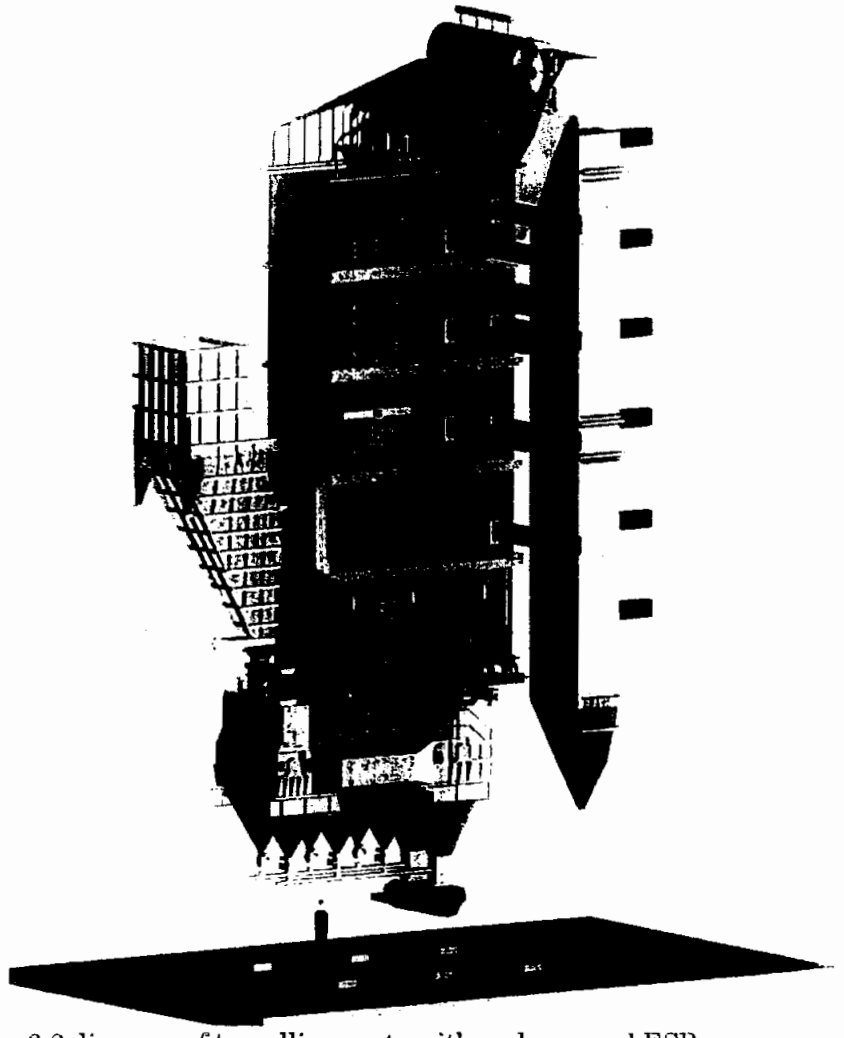


Figure 6.2 diagram of travelling grate with cyclones and ESP

6.6.5 Stack Height determination

There is no regulation in national environmental law which determines the height of the stack. However, ground level concentration of SO2 has been restricted to 50 ug/m3 increase on ground level. The ground level concentration is mainly influenced

parameters. By considering the direction of the wind and dispersion for each stack of the proposed site, it is proposed that stack height of 60 meters is a must to disperse the air pollutants effectively to save the public health.

6.6.6 Cumulative Impact on Air Quality

Sheikhu sugar Mills is near the proposed project. During crushing season two types of air pollutants will be emitted. Firstly sugar cane trolleys increase road dust level and then stacks of Sheikhu sugar mills emit fly ash which may exceed the air quality level in the area. This air pollution may affect the intake air system. Additionl filters will have ot be inserted for cleaning of intake air. The impact of existing road and its traffic has negligible impact on the site. In case of addition of small number of trolleys of bagasse will not have any significant imact on the air quality on road sides. Hence, mapct of operation of Sheikhusugar mills will have significant impact whch needs to be mitigated throuhadoption of air filter system.

6.7 Protection of crops and live stock

The proposed sites of the plant are dominantly an agricultural area where crops and livestock are important source of income. The air pollution for long time exposure may damage the crops and affect the produce adversely. EPA has no defined secondary standards to protect the materials, crops and live stock. But it is necessary to protect these properties of the farmers which are formal and informal source of income.

Live stock reared in the area

Cash crop of the area

SO2 and O3 are the main gases which has potential to damage the crops. The secondary ambient air quality standards which protect the decrease in visibility,

levels of ambient air quality for ozone are 157 ug/m3. The emissions from the plant will be well below the secondary standard levels. Therefore, it is safely assumed that the emissions of the power plant will not adversely affect the properties of the people especially animals and crops.

Therefore, impact on plants and animals is foreseen as ***insignificant***.

6.8 Public Health

The operation of the plant will emit the PM which has potential to affect the public health if left unabated. Primary air quality standards have been notified by the government in 2010. The air quality standards are made while keeping the safety margin which ensures the safe environment for human and its health. The levels of PM10 , SO2, NOx are fixed 150, 120 and 120 ug/m3 respectively by government of Pakistan. The air quality criteria given by World Bank Group also fixes the levels of SO2, NOx and PM10 as 150 ug/m3 for each parameter. World Health Organization has given the guidelines values for PM_{10}, $PM_{2.5}$ values which has least chance of long term exposure to the population. It has been suggested that if PM_{10} value may be kept below 70 ug/m3 (annual average) , the chances of mortality and morbidity are almost reduced. The expected emission of PM_{10} form the stack is going to increase the level up to 34 µg/m3. Similarly the safe limit for SO2 is proposed 50µg/m^3 in NEQS. The guideline values of WHO are 150 for PM10 which reduced effect like mortality, morbidity on human.

Ozone is another pollutant which has potential to damage/impair the building materials, rubbers, lungs, cardiovascular system if exceed certain level. WHO guidelines 2005 have restricted the ozone level to120 ug/m3 for eight hour exposure. Keeping in view the certain studies made in Europe, it was suggested that the limits of Ozone may be reduced to 100 ug/m3 for daily maximum mean for 8 hours. Present levels of ozone at site are is 30 ug/m2 during month of August. The NO2 at site was measured 9 ug/m3. The contribution of NOx from plant is estimated 70-80 ug/m3. NO2 and hydrocarbons contribute to form O_3 in presence of solar radiation. Keeping in view that all the parameters of air quality will be kept within NEQS and WHO guideline values therefore; the increase in ozone is seen minimum. However, it is suggested

6.9 Archeology

No archeology site has been identified near the proposed site.

6.10 Public parks and tourism

No tourism site is near this site which receives any effect of the plant activities.

6.11 Sustainable Environmental benefits (CDM)

The bagasse fired projects has benefited the environment by reducing the greenhouse gases (GHGs) in the atmosphere in terms of the usage of biomass as fuel. Bagasse and other biomass, which are renewable, can play a major role in substituting fossil fuel for future power generation. There is a potential of >1000 MW bagasse based cogeneration potential and >2000 MW other biomass power potential in the country. A typical cogeneration potential of 22 MW exports nearly 0.3 million units of electricity in the season with a gross generating capacity of more than 150 million kWhs in a year and thus can offset nearly 0.166 million tonne of carbon dioxide. The Clean Development Mechanism (CDM) of the Kyoto Protocol can be an effective tool in the sugar sector creating a major impact by the way of technological and financial transfer between Pakaitan and developed countries and can help start the transition towards truly environmentally, economically and socially sustainable energy systems. The carbon credits generated in the process would also create an additional market for these environment friendly technologies.

Summary

In the light of above given technological mitigation measures, the emission of PM, SO2, and NOx will be within the NEQS limits; therefore, impact of air emission on environment is ***not significant***. *The impact of CO2 emission is neutralized in biomass based combustion. Therefore, bagasse is environment friendly as compared to coal and oil.*

Summary of adverse impacts during operation phase are summarized in next table.

	Physical Environment							Bio-Environment		Socio –Economic Environment							
Environmental component / Project Activities	Topography	Land Acquisition	Soil Quality	Landscape	Surface water Quality	Ground water quality	Air Quality	Noise and Vibration	Flora	Fauna	Agricultural land	Health & Safety	Disruption of public utilities	Employment	Population Disturbance	Social Disorder	Loss of Heritage value	[illegible]
PM from Stack Emission	O	O	O	O	O	LA	O	O	O	LA	LA	O	O	LA	O	O	[illegible]
SO2 emission from Stack	O	O	O	O	O	O	O	O	O	O	O	O	B	O	O	O	[illegible]
NO2 emissions	O	O	O	O	O	LA	O	O	O	O	LA	O	B	O	O	O	[illegible]
Storage of chemicals or lubricants	O	LA	O	LA	LA	O	O	O	O	O	LA	O	O	O	O	O	[illegible]
Relocation	O	O	O	O	O	O	O	O	O	O	O	O	O	O	L	O	[illegible]
Traffic during cane crushing	O	O	O	O	O	LA	LA	O	O	O	LA	O	B	LA	O	L	[illegible]
O3 formation	O	O	O	O	O	LA	O	O	O	LA	LA	O	O	O	O	O	[illegible]
Greenhouse gases	O	O	O	O	O	O	O	LA	O	O	O	O	O	O	O	O	[illegible]
Land use change	O	LA	B	O	O	LA	O	O	O	B	LA	O	B	O	O	L	[illegible]
Pumping of ground water	O	O	O	O	B	O	O	LA	LA	B	O	O	O	O	O	L	[illegible]

Waste water disposal	O	O	O	LA	O	O	O	O	O	O	O	O	O	O	O	O	
Ash disposal	LA	LA	O	O	MA	O	O	O	O	LA	LA	O	O	LA	O	O	

O=Negligible/No Impact B=Beneficial LA= Low Adverse MA= Medium Adverse HA= High

The resulting CO_2 emissions from bagasse firing are equal to the amount that the sugarcane plant absorbed from the atmosphere during its growing phase, which makes the process of bagasse firing greenhouse gas-neutral. It has significant impact on climate change and crops pattern. The emission of CO2 has not been included in NEQS or any legislation at national or international level. The efforts to reduce the GHG are voluntary in nature. The alternative fuel like bagasse may be the best option to reduce GHG. In addition to the above said steps vast plantation will be carried out in and around the plant to reduce the effect of GHG. The impact is made **neutral** with bagasse fuel.

6.12 Water Pollution

6.12.1 Surface Water

Total circulating water of 2500 m3/hour will be circulating and 1-2 percent of this will be added as evaporated. The cooling water will be recirculated after cooling and mixing with fresh water. The waste water generated will be in low quantity and disposed in the **rohi drain.** The main source of water pollution from process of power plant is boilers blow down. which will have some TDS and pH issue which will be adjusted through mixing in cooling water pond. The oil and grease will be controlled by good housekeeping and any oil layer found in the effluents will be separated through a oil separation system. The rest of the waste will be within NEQS which will not need treatment.

The municipal part of the waste water will be treated in a waste water treatment plant to bring the BOD5 and COD within the NEQS. The treated water will be disposed off in drain passing by the proposed site. The treated water complying NEQS will not affect any surface water body in the area. It is safe to describe that installation of 30MW power plants will not disturb the quality of water in the surface water source passing by the plant. The waste water quality will be monitored and submitted to EPD on monthly basis.

The cooling water will be drawn from the subsoil water 2500 tons per hour water is expected to be used from two tube wells at site.Therefore, no imact on surface water bodies is foreseen.

Total water required for this power plant is 2500 m3 per day circulating in 1.32 fitted steam turbine and 2.5 tons per day (0.001 cusec) for utilities purpose. It will be drawn from ground water thought two bore holes of 1.5 cusec. One of them will be kept standby.The ground water study shows that the aquifer has enough water at proposed site. Presently, water table at site is at 5-6 meter depth. The impact of pumping of ground water from ground water through two tube wells of 1.5 cusec each to meet the operational requirement will not affect the ground water adversely.due to its recharge source of River Chenab.

Waste water standards

Parameter	NEQS	WGB,1998
pH	6-10	6-9
Temperature(^{0}C)	≤ 3	≤ 3
Biological oxygen demand (BOD mg/L)	80	-
Chemical oxygen demand (COD mg/L)	150	-
Total dissolved solids (mg/L)	3500	-
Total suspended solids (mg/L)	150	50
Oil and grease	10	10

6.12.3 Wastewater and its Disposal

The waste water generated from the utilities like boiler @ 2.5 tons per day (using yardstick of 51 LPD).Total maximum 50 persons are expected to work during operation phase of the plant. Which will generate 0.0010 ft^3 per sec (cusec) of municipal waste daily. It will be treated with three stage septic tank and disposed off in the drain. The waste water be compliant of NEQS regarding BOD, COD, TDS, and oil and Grease. Therefore no impact of the drain is foreseen during the operation phase.

Summary

The disposal of treated waste water into the drain will have **no adverse effects** on drain after taking the remedial measures of treatment as explained above.

6.13 Noise

The operation of the plant will generate noise more than 90 dB(A) from fans and other operations in the plant. The standards of noise in industrial area are 65 and 75 for night and day time respectively.

Noise Emission standards

Sr.no.	Parameter	NEQS (dBA)		WBG,1998	
		Day time	Night time	Day time	Night time
1	Residential area (A)	55	45	55	45
2	Commercial area (B)	65	55	70	70
3	Industrial area	75	65	70	70

World Bank Guidelines permit the noise of 70 dB(A) in industrial area. The noise will not exceed these limits with following steps to reduce the effect of noise:

- Main Transfer and transfer for plant will be built next to each other.
- Select the special equipment of low noise.
- Plantation at enclosure wall to reduce noise.
- Installation of sound proof cover at turbo set.

The following measure will be included to reduce noise at the ID fans, draft fans and over air fire fan.

- Installation of muffler device at inlet.
- Set up guide device to remove vibration
- Shell of fan would be covered by material of sound absorption, if required.
- Additional sound proofing will be done to keep the noise low in control room.
- The monitoring of ambient noise regularly.

The nearest population is Patti Naich and Ghlam Ali which are about 2KM from site where noise will be restricted to 55 dB(A) on day time. The distance of the population will disperse the noise power and least effect is expected to reach in the nearby villages.

During operation stage, the plant machinery will be located in covered areas with fairly thick walls and high roofs. These measures will prevent any noise during operation phase of the plant.

The impact of noise on nearby population will remain minimum through adoption of above said measures.

About 5 percent of the bagasse is left as ash . IN this way 6000 tons of bagasse will generate about 2.8 tons of ash daily. This ash will be stored in ash disposal facility with properly lined and membrane to stop the leaching from ash storage. The ash storage facilities will be properly lined to avoid any seepage and ground water contamination. The ash storage facility is being proposed for about 4 years but at the same time efforts will be made to use the ash in alternate usages like:

- Agriculture as manure
- Road construction material
- Raw material for cement factory

The sludge from waste water treatment plant will also be stored and reused like ash to safeguard the environment

6.15 Conclusion and Recommendation

As discussed above adequate control measures will be applied for particulate emission, ash and water pollution abatement. Therefore, the plant is not likely to cause any significant air or water pollution in the area after adoption of mitigation measures.

The plant operation system will be monitored in such a way that a strict check would be imposed to stop any water or air pollution in the atmosphere excess to NEQS.

6.16 Fire Protection and Other Hazards

An efficient Fire protection system will be provided for controls and measures of mitigation of accidents and associated risks by setting objectives and following applicable and other requirements. Firefighting squad will be present in the mills which will be equipped with fire fighting tools. All possible places of fire will be provided with fire extinguishers and fire water hydrants. Fire alarm will be fixed in the factory.

6.17 Traffic Management

As the project is being proposed at main road of 30 feet and in good condition. But the big industried in the area uses this road for carrying of raw material and finished goods.The main trucks carry oil for KAPCO, from Pak Arab Refinary and sugar cane for Shekhu sugar Mills.Therefore problem of the traffic is fore seen especially during cane crushing season. Itional bagasse will be transported fromo outside, therefore, no addition of traffic is foreseen due to this project in operation phase. The impact of traffic is negligible during operation phase.

6.17.1 Signboards, Warning Boards

Sign and warning boards are mandatory to keep laborers and workers at factory informed about the hazard associated with the activities at sites. These issues will be addressed by the constructor/contractor and covered in an Occupational Health and Safety (OHS) department of the contractor.

6.18 OCCUPATIONAL HEALTH AND SAFETY

All the labour and workers in will be employed through a recruitment contractor. The contractor will be responsible for the safety of the workers at the industries and other occupations. The major labor laws which may come across are as follows:

- Factories Act 1934.
- West Pakistan Shops and Establishment Ordinance, 1969
- Payment of Wages Act, 1936.
- Workmen Compensation Act, 1923
- Standing Orders Ordinance, 1968.
- Industrial Relations Ordinance, 2002
- Employment of Children Act, 1991

Based on those acts and ordinances, workers are protected and educated accordingly. The new plant will address the safety issues in a better way through providing PPE and proper training. During construction activities the contractor will ensure the wage interests of the labour.

The construction, operation and maintenance contracts demand from the contractors to provide the standing instructions, Operation and Maintenance (O&M) procedures for safe and efficient operation of the unit. Plant management and contractors are required to meet the following conditions:

- Observe the occupational Safety and Health Administration (OSHA) guidelines
- Submit safety procedures to the owner and to follow such procedures.
- Maintain complete first aid facilities with qualified first aid personnel.
- Prevent any harmful effects likely to occur during projects execution, operation and maintenance of the plant.

The following measures will be taken for health and safety assurance:

- Plant Zoning, Assembly Points and Emergency Exits

- Fire Fighting Post with all necessary facilities
  - Fire Extinguishers
  - Fire Hydrants
  - Fire Boxes
  - Bucket Stands
  - Fire Hose Reels
  - Electric Fire Alarms
  - Fire Monitor
  - Dedicated Phone Line
  - Fire Extinguisher Filling Facility (water type)
  - Water Reservoir
  - First-aid points at different plant locations
  - Trained personnel ready at Post to tackle any emergency

- Safety [illegible]
- Safety training of new employees
- Refresher trainings for all employees
- Accident Reporting and Investigation process
- Yearly Medical Check-up of employees
- Health Awareness Week

The management of the plant will also conduct monitoring of Occupational Health and safety affairs during construction and operation phase of the project.

CHAPTER 7

ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN AND MONITORING

7.1 GENERAL

This section provides brief description of environmental issues, mitigation measures to contain eliminate and/or reduce environmental and social impacts to an acceptable level, institutional arrangement for the implementation of the mitigation measures and also carrying out environmental monitoring for air quality, water quality, and noise pollution related parameters.

This ESMP is a delivery mechanism for environmental and social mitigation measures made in the Assessment Report. The purpose of the ESMP is to ensure that these recommendations are translated into practical management actions which can be adequately resourced and integrated into the Project phases. The ESMP is, therefore, an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of construction, operation and decommissioning are prevented and that the positive benefits of the Projects are enhanced (Lochner, 2005).

The Environmental and Social Management Plan (ESMP) is developed to eliminate and / or mitigate the impacts envisaged at the design, construction and the operational stages and provide specific guidelines for long-term monitoring by identifying the roles and responsibilities of the Proponent, Design Consultant, and Contractor(s).

The reason for making ESMP is to eliminate and mitigate the potential impacts at the design, construction and operational stage of the project. It provides the specific guidelines for long term monitoring by identifying the role and responsibilities of the proponent, design consultant and contractors.

The social and Environmental management Plan includes:

- Construction Management Plan;
- Traffic Control Management Plan;
- Waste Management Plan;

- Local Employment Policy;
- Occupational Health and Safety Policy;
- Emergency Response Plan.
- Environmental management plan

This project is bagasse absed project with limited environmental adverse effects of fly ash control , therefore only EMP is discussed in this report.

7.2 OBJECTIVES OF THE ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) will help the management to address the future likely negative impacts of the proposed Project, enhance the Project's overall benefits and introduce standards of good environmental practice. The primary objectives of the EMP are to:

- Define the responsibilities of the Project Proponent and other key players during the design, construction and the operational phases;
- Facilitate the implementation of the mitigation measures by providing technical details of each project impact, and proposing an implementation schedule of the proposed mitigation measures;
- Develop a monitoring mechanism and identify monitoring parameters to ensure that all the proposed mitigation measures are completely and effectively implemented;
- Identify training requirements at various levels and provide a plan for the implementation of training sessions;
- Identify the resources required to implement the EMP and outline corresponding financing arrangements;
- Providing a cost estimate for all the proposed EMP actions.

Following are the key [illegible] and recommended [illegible] during the design, construction and operational stages;

- Selection of clean technology and new plant machinery for efficient performance and emissions.
- Traffic management during transport of material during construction and operation especially during cane crushing season
- Implementation of mitigation measures at Construction activities
- Bringing down the pH, oil and grease and heavy metals within the NEQS from process waste water effluents
- Treatment of municipal waste water and its monitoring on quterly basis.
- Control of air pollution(PM) from stack);
- Control of dust in handling of bagasse.
- Maintenance of Noise levels within NEQS;
- Monitoring of Emission from stack gases with respect to PM, SO2, NOx, and CO on quarterly basis.
- Monitoring of ambient air quality with respect to PM10. PM2.5, around the plant area.
- Handling of ash and its safe disposal ;
- Health and safety of workers and
- Identification and Development of ash reuse or recycling as long term policy
- Interaction with the people of the area for feedback on social and environmental control measures

7.3 SPECIFIC IMPLEMENTATION RESPONSIBILITIES

This section describes the responsibilities of different functionaries during the design, construction and operational phases of the proposed project.

7.3.1 Stakeholders Role and Responsibilities in EMP

a) Contractor(s)

a) [illegible]

b) Manager (operation)

c) Officer (Environment, Health and safety)

d) Social welfare officer, Public Relation officer

7.4 ENVIRONMENTAL MONITORING AND IMPROVEMENT SYSTEM

7.4.1 Design Phase/ Pre-Construction Phase

Proponent of the project Sheikhu Power (pvt) Limited is responsible for ensuring that the proposed Project design and specifications adequately meet the national environmental standards given in NEQS SRO 2000 and SRO 2010 (**annex-I All NEQS**) and ensure the implementation of proposed steps reflected in the EMP. The responsibilities of GM and other power plant officers and staff would be as follows:

i) To ensure that technology and design of the plant may be energy efficient which bring down all the parameters of gases, water and noise within the NEQS including PM.

ii) To get IEE approved from EPD Punjab;

iii) Setting up systems for environmental management; and

iv) Incorporating environmental mitigation and socio-economic measures in the design / tender document.

7.4.2 Construction Phase

The proponent and Contractor(s) will be responsible for compliance of environmental mitigation measures for the proposed Project, while project coordinator and GM plant will arrange monitoring the compliance.

The proponent will incorporate all environmental requirements and plans contained in this IEE in tender document.

During construction phase, the Contractor(s) employed after following prescribed procedure and fulfilling all the required codal and procedural formalities,GM plant will be responsible for the implementation of the proposed mitigation plan, in letter and

[illegible] be [illegible] and [illegible] with [illegible] managing the environmental impacts of the contractor, to safeguard, mitigate adverse impacts and rehabilitate the environment should be addressed through environmental provisions in the contract document and through adequate implementation at site. Plant administration will also be responsible for conducting frequent meeting with the surrounding people to clear the misconception about the project regarding air pollution and adverse impact of the smoke.

7.4.3 Operational Phase

Long Term environmental monitoring (till the plant life) would be conducted at completed site at post closure stage to ensure that there is no release of contaminants from the site that may impact the health of the surrounding environment and violation of NEQS.

The general manager (GM) Power plant through his designate officer not below the rank of Manager will be responsible for the following:

i) Coordinating with the operation staff working to monitor environmental compliance during the operation of the plant.

Following issues will be given specific consideration for monitoring and reporting to management and EPD for their compliance;

- BOD5, COD, TSS, TDS, oil and grease, Chlorides, sulfates, Ni, Chromium, Fe, Mn, etc from waste water effluents on quarterly basis.
- Stack emissions for gaseous (SO2, NOx, CO) and particulate matter.(PM) on quaterly basis from a certified Environmental lab.
- Ambient noise at the boundaries of the plant and working places.
- Ensure the Health and safety of workers;
- Any Change in local socio-economic conditions.

i) Providing training and equipment for self-monitoring, assessment of short-term and long-term environmental impacts of bagasse based power plant during operation phase.

ii) [illegible]

quality standards.

ii) Deployment of trained and dedicated staff to monitor the quality of the effluent and emissions and its periodic reporting on monthly basis regarding compliance of NEQS to EPA, Punjab.

iii) Proper maintenance of the pollution control equipment and its function.

iv) Management of ash issue and keep its record.

v) Similarly Occupational Health and Safety measures will be implemented and monitored to check the effects of plant operation on the O&M staff and maintenance of the plant.

vi) Assure the adequate funds allocation for the implementation of EMP.

Table 7.1:

Environmental Management Plan (EMP) for 30 MW Bagasse Fired Power plant

Sr. No.	Adverse effect	Action proposed	Responsibility
1.Planning stage			
1	Land acquisition and Resettlement plan	• Not required as the land is alsready with the proonent	-
2	Livelihood loss	• Not required	-
3	Air pollution control technologies	• Selection of best fuel efficient design, better environmental performance and HHV fuel and technology	Management of the plant
4	Air pollution and water pollution treatment system	Provision of air pollution and waste water treatment plant at designing stage	Management of the plant
5	Right site selection	The project meets the criteria.	-
2.Construction Phase			
6	Air pollution	Vehicles delivering coal and	Project manager

		[illegible] earthworks period [illegible] • Mask and other PPE shall be provided to the construction workers. • Low Sulphur diesel shall be used in DG sets as well as construction machineries. • Low NOx and low noise generators will be employed • Washing of roads where dust is deposited	
7	Water pollution	• Settling tanks shall be provided to prevent to discharge of excessive suspended solids. • Toilets will be provided for construction workers and waste water generated from toilets will be treated in septic tank • To prevent contamination from accidental spillage of Oil the storage areas will be bounded and will be inspected and cleaned at regular intervals.	GM and manager EHS

		[illegible] Identified sensitive locations or near the noise source during construction. • Ensure machineries meeting noise Level standards. • Personal protective equipment will be provided to the workers.	
9	Soil Pollution	• To avoid soil contamination fuel and lubricants shall be stored at the predefined storage location. • Septic tank or mobile toilets fitted with anaerobic treatment facility shall be provided during construction phase. • Non-bituminous wastes should be dumped in borrow pits with the concurrence of landowner and covered with a layer of top soil conserved from opening the pit.	Contractor and Officer (EHS)
10	Worker's health and safety	• Providing adequate warning signs. • Providing workers with skull guard or hard hat • Contractor shall instruct his workers in health and safety matters, and require the workers to use the provided safety equipment.	Contractor and HSE incharge officer.

		good engineering practices.	
6.5	Operation Phase		
12	Bagasse transport	All the bagasse will be taken Sheikhu sugar mills, it will not exrt any extra pressure on the existing infrastructure	-
12	Air Pollution	• Smooth operation of ESP • Water spraying also conceived in ash silo is for suppression of fugitive dust in ash silo area. Vehicular speed inside the project area will be restrained to 15 kmph to reduce the possibility of emissions. • Washing of road where dust is deposited. • Monitoring of stack emissions and ambient air quality around power plant and receptor area	Manger operation Manager operation and Officer EHS
13	Water pollution	• Good housekeeping for oil leakage during plant operation • Operation of waste water treatment plant	EHS officer General manager and EHS officer
14	Monitoring of Water pollution	Monitoring of waste water effluents According to NEQS of industrial waste SRO 549	Manager operation and EHS officer

	[illegible]	[illegible] shall be fully in compliance with the national and local regulations and with effective silencing apparatus to minimize noise. • As a rule, the operation of heavy equipment shall be conducted in daylight hours.	[illegible]
16	Checking of compliance of Noise regulations	• Noise levels at the plant boundaries on monthly basis	EHS officer
17	Fly Ash disposal	Disposal facility preparation as per environmentally safe	EHS officer and GM
18	Recycling and reuse of ash	Utilization of ash for local uses as manure etc.	GM, and officer (EHS)
19	Mitigation of GHG	Although it is environment friendly project with respect to GHG yet plantation of trees on maximum area with local and indigenous species especially Delbergia Sissoo will be made	GM, and EHS officer
20	Traffic management plan	The traffic management plan for trucks so that they may not affect the traffic [illegible] crushing season.	Admin officer and EHS officer
21	Environment policy	Development of environment policy	G.Manager and EHS officer.
22	Social compliance	Interaction between the management and people of the area	Manager admin and administrative officer
23	Monitoring and reporting	Monitoring [illegible]	Manager (operation) and EHS officer

			reporting to the plant management and EPD on quaterly basis	
24	Record keeping		Record of monitoring reports	EHS officer
25	Emergency plan		Working and maintenance of all health and safety equipment, firefighting equipment and extinguishers	EHS officer
26	Compensation in case of causalities		In case of any injury to worker, compensation / insurance may be paid	Owner and GM
27	Training of staff on health and safety		Regular training on health and safety is required	Manager operation and EHS officer
28	Budget for EMP		To ensure the provision of budget for environmental management	GM and owners of the project.

7.5 ENVIRONMENTAL MONITORING SCHEMES

7.5.1 Compliance Monitoring

In this context, compliance to the regulations set by the Ministry of Environment and EPD Punjab to limit air, water and soil pollution shall be observed. Compliance monitoring requirements include effluent quality testing, stack emission testing, noise testing, drinking water quality and ambient air quality monitoring on monthly and quarterly basis. Compliance monitoring shall be the responsibility of the power generation facility administration and GM (Power plant) and monitoring activities shall be budgeted for accordingly. For effective compliance monitoring, the following shall be assured:

i) Trained staff (facility operation, laboratory staff, maintenance team, etc) and pollution responsibilities

iii) Provision of safe storage and protection of records

iv) Timely changing /replacing of pollution control equipment.

v) Frequent visits to local community for social compliance

7.5.2 Process Control Monitoring

The quality of the emissions and effluent will be monitored by Plant management from any certified environmental laboratories as described in the compliance monitoring scheme. Within the framework of the monitoring procedures carried out by external laboratories the correct measuring and documentation of environmental parameters i.e. NEQS at regular intervals as prescribed by the Government and laid down in the conditions of environmental approval.

7.5.3 Record Keeping and Reporting

Monitoring efforts would be in vain in the absence of an organized record keeping practice. It is the responsibility of the plant administration to ensure the development of a database that includes a systematic tabulation of process indicators, performed computations, maintenance schedules, logbook, and compliance and process performance monitoring outcomes. Such a historical database benefits both the facility operator and design engineers.

The GM power plant and manager should submit a periodic Compliance Monitoring Report to the assigned regional authority, namely the EPA. Such record keeping shall be requested and assured by the EPA.

7.6 TREE PLANTATION PLAN

Plan for development of buffer zone for attenuation of the noise and nullify effect of CO2 gases may be made. The plant will be grown on remaining site of the plant after completion of the project. The cost of the plantation may be allocated in the budget.

7.6.1 Trees to be Planted

Tree plantation will be carried out along boundry line to act barrier to control escape of noise in the surrounding areas. As a part of tree plantation plan, plants which are moderately tolerant to the pollutants but are endowed with fast growing, dense foliage canopy will be planted. The number of plants to be grown along the boundary line of the area will be estimated after physical survey after completion of construction and will be appropriate in number in single row with a tree to tree distance of 3m. The trees planted here will have dense spreading canopy. This act will increase the aesthetics of the area. So the trees grown in this area must be flowering as well ornamental plants. All along the boundary of the plant, a strip of plantation with trees which are tall in nature and evergreen in habit. This area will act as a barrier and as far as possible check on CO2 emission.

The following trees are recommended to be planted here:

Table 7.2: trees recommended for proposed plant site

Sr. No.	Local Name	Scientific Name
1.	Neem	Azadirachta indica
2.	Tali	Dalbergia sissoo Roxb.
3.	Kikar,	Acasia arabica
4.		
5.	Khajoor	Phoenix dactylifera Linn.
6.	Bairi	Ziziphus mauritiana Lamk
7.	Peepal Tree	Ficus religiosa
		casia

7.1 Training

The Environmental Management structure of power plant will be made capable of implementation of EMP. However, its capacity will be strengthened to address environmental, social, Operational, health and safety issues for the proposed plant. Under Environmental Management and Training, it is proposed to provide a three level hierarchical structure for environmental and safety management. The first level shall comprise professionalism from the engineers and supervisors and shall be responsible for monitoring and recording of treated water effluent, noise levels etc. to confirm that the plant is operating in compliance with national Environmental Quality Standards (NEQS). Plant personnel will submit records to enforcement, as required to ensure compliance with environmental and occupational safety regulations and NOC conditions. A full time environmentalist and laboratory technician will be provided training and equipment to monitor the emissions, noise and effluent quality for compliance with NEQS.

The second level shall be the oversight function to be performed by senior management of power plant with feedback from Environmental and Safety staff, shall be responsible for providing direction and training, to keep personnel up to date on equipment operation, environmental regulations, and safety practices. This training shall comprise environmental control, monthly safety meetings for plant personnel, training on fire fighting and emergency response, safe handling of plant chemicals and quality of effluent and emission. Plant personnel will also be kept informed of new environmental regulations and safety practices.

On the third level, the BM and Manager shall have regular session /communication with senior plant engineers to keep them informed of the condition of the plant with respect to Quality, Environmental, Health and Safety issues. The plant management and relevant staff at the plant will maintain a proper record of all these activities.

The responsibilities of the plant management and relevant staff are as follows:

proposed Project and to take steps to minimize the adverse impacts, if any, caused/ likely to be caused to the existing environment.

- To organize routine monitoring of treated effluent, air pollution, noise, vegetation, health, implementation of safety measures, motor vehicle emission of plants etc.
- To develop operational guidelines and implementation schedule;
- Receiving complaints from residents and institutions and assisting the local environmental authority including liaison with EPD, Punjab;

7.7.2 Cost of the Environmental management

The cost of EMP includes:

i. EHS officer, technicians and lab assistants
ii. Personal protective equipment
iii. Fire fighting equipment
iv. ESP installation
v. Bowsers for water sprinkling
vi. Waste water treatment plant
vii. Consumables of WWTP
viii. Ash transport
ix. Ash disposal facility including cost of land
x. Air quality monitoring
xi. Stack emission monitoring
xii. Drinking water monitoring
xiii. Vehicular emission monitoring
xiv. Waste water monitoring
xv. Reporting and record keeping
xvi. Tree plantation

The monitoring cost is calculated below which comes out to be Rs. 780,000 per annum. The cost of the land required for ash disposal has not been considered in the

Table - 8 Showing the monitoring [illegible]

Components	Parameters	Frequency	[illegible]	Cost (Rupees/-)
Air Quality	CO, NOx, SOx, PM10,03 and HC	Quarterly	[illegible] life	2,40,000/-
Ground Water Quality	Total Coliforms, Fecal E. Coli, Total Colonial Count, Fecal Enterococci, pH, TDS, Total Hardness, Nitrate, Chloride,Sodium	Bi-annually	Plant life	40,000/-
Noise Level	-	quaterly	Plant life	10,000/-
Stack emission	CO, NOx, SOx, PM10	50,000/-		200,000/-
GHG	Tree plantation and maintenance of lawns	Monthly 20,00[illegible]	[illegible] life	240,000/
Health and safety	PPE		life	100,000/

Table 7.4 Summary of Environmental Assessment and Mitigation Plan

Subject	Environmental and Social impacts during various Project Phases			Proposed Mitigation Measures
	Planning	Construction	Operation	
Socio Economic impacts				
Decrease in Load shedding	Nil	Nil	Up to 26 MW will be added to national grid which will reduce load shedding	Positive impact
Resettlement	No New resettlement required as site is agricultural and no house within the site.	Estabiishment of small tents and container as site offices for labour and staff shelter. Canteens within the plant Will also be set.	Nil	Not required as no structure [illegible] to be demolished.
Land acquisition	The proposed land is in possession o fthe owner since many years.	Nil	Nil	Not required
Change in Land use	Not significant	Agricultural land will be shifted to the industrial land use which will generate 12 times more income.	Nil	Not required as this change will bring significant positive [illegible]
Employment	Positive Few officers have been employed by	Job opportunities for unskilled, semiskilled and skilled workforce	About 50 personnel of all categories will be employed	Max. Workers will be recruited [illegible] local persons. Positive impact expected on local economy

	proponent while dozen of people are working on feasibility of the project.	at local level.		provincial level
Cultural resources	Nil	People from different sources will come for labour up to 100 for construction of the plant. They will confined to plant premises.	50 people are expected to be employed which will work in plant and reside in the plant.	The employees will be within the plant and very little people are expected to dwell in nearby villages therefore, negative impacts on cultural values of the nearby [illegible] are not foreseen.
Camp management	Nil	Solid and human waste disposal may contaminate soil	Nil	The solid waste will be collected in bins of different colors. Valuables will be sold to recyclers while the solid waste will be dumped at the dump site.
Socio-economic conditions gender	Nil	Income of the individuals is likely to increase.	Employment will increase the income level of each person.	Positive impact
Public health	Nil	Dust , noise and vibration may affect public health	SPM, may affect public health	• Water sprinkling [illegible] intervals during [illegible] phase. Machinery [illegible] noise and emissions will be employed during construction. Noise generating activity will be done during night. • Ambient air quality [illegible] which protect the public health will be [illegible] strictly [illegible]

				control. These standards are yardstick for saving of public health.
Permissions from controlling authorities	Consent from, irrigation, NTDC are to be obtained	Permission (NOC) for construction will be obtained from EPD under section 12 of PEPA 1997. Department of irrigation Permission from [illegible] for water and [illegible] waste wate water in drain.	Permission (NOC) for operation will be obtained from EPD.	• A reliable and seasoned consultant has been hired for preparation of IEE. The [illegible] work of consultant and Habib Power Pvt. Limited will assist in procuring the NOC under section 12

Subject	Environmental and social Impacts During Project Phases			Proposed Mitigation Measures
	Planning	Construction	Operation	
Environmental impacts				
Geology and soils	Nil	Erosion, soil compaction, and [illegible] may happen due to construction activity	Soil contamination may happen due to oil spillage	Area is flat, erosion is not expected [illegible] storage and handling will be done with [illegible] control any spillage or leakage [illegible] soils, protective liners, and curbing [illegible] controls for runoff from storm water will be applied.
Land acquisition	Not significant	Not significant	Not significant	Land is already with owners since [illegible]
Air Quality				
Air Pollution (gaseous and particulate emissions and heavy metal)	Not significant	Smoke and emissions of fugitive dust due to movement of heavy vehicles on site	significant due to the following:- bagassel burning in the boilers and emission of PM	**Planning Stage** • Selection of travelling grate [illegible] • Selection of dust control [illegible] • Ensuring that emissions from the [illegible] within the NEQS. **Construction Phase** • Minimum digging will be involved [illegible] foundation. • The excavated soil will be levelled [illegible] • Water Sprinkling on muddy and kutcha routes during construction phase.

				• Planned siteing of piled material • Fencing of excavated site or covering of excavated soil • Speed control of moving vehicles **Operation Phase** • Use of carrying belt and bulldozers in loading and unloading of fuel • Use of cyclones and ESP for [illegible] collection in stack emissions. • Travelling grate combustion and [illegible] NOx within the NEQS. • 60 meter high stack • Compliance of NEQS. • Regular monitoring of air pollutants
Noise pollution	Not significant	[illegible] due to [illegible] machinery	Significant [illegible] turbo generators and other machinery	• Mitigated through [illegible] blow with noise [illegible] • Location of transformers [illegible] other. • Low noise Fans • The covers of ID fans provided with noise attenuation covering • installation of plant within the [illegible] hall. • Site selection away from [illegible]

				area. • Addition of noise barriers at plant property line if necessary.
Dust pollution	Nil	Soil stripping, storing and handling create fugitive dust problem	Piles of bagasse and its handling activity like conveyers may cause dust issue	**Construction Phase** Mitigated by: • Confining the construction activity to sprinkling of water on loose soil piles dust during construction phase. • Removing the soil as soon as it is generated. **Operation Phase** • Location of main plant stacks opposite to wind direction from bagasse handling yard/area. • Pavement of the plant area where loading truck pass
Climate change and Green House gases	Negligible	Not significant	Emission of CO_2 is nuetralised in bagasse burning.	• Bagasse firing has environmental and is just recycling of CO_2 in the ecosystem • plantation in and around power plant
Environmental impacts	**Planning**	**Construction**	**Operation**	**Mitigation measures**

Water resources				
Water Pollution	Not significant	Significant due to working of about 100 labor at site	• Significant due to presence of SO4 and pH in waste water. • Storage of water in pond • Municipal part of the waste water	• Treatment of waste water to bring it within NEQS. • Septic tanks will be constructed in construction phase • Quality of effluent of plant will be monitored and reported on regular basis to check efficiency of treatment system.
Groundwater quality	Not significant	Not significant due to absence of any such activity which may affect ground water contamination.	Drawing of ground water for boiler and coolers Spilling of oil or chemicals	• The underground water reserves enough for the operating life of the Plant due to good recharge mechanism river Chenab and rain water. • Storage of chemicals and oil in confined designated paved area • Handling by trained staff • Control of leakage or spilling
Domestic Solid Waste	Not Significant	• significant as loose soil or construction	Not significant as small quantity from operating offices and	• Private contractor will collect the construction soil or debris and

		debris during construction of proposed plant • solid waste from labour camps	canteen will be produced.	site. • Small quantity Office waste will be handed over to contractor who will carry it to municipal/local government waste collection point for final disposal. • The recycling of useful items in the waste like wood, board and [illegible]
Metal leaching	Nil	Not significant	Not significant	Not required

Subject	Environmental and social Impacts During Project Phases			Proposed Mitigation Measures
	Planning	Construction	Operation	
Environmental Impacts				
Industrial solid waste (Ash)	Nil	Nil	Significant due to generation of ash collected in ESP and ash removed	Mitigated through: • Making it fertilizer in fields

			from the boiler	• Compact material for construction of [illegible] • Proper storage facility within plant for [illegible]
Noise and vibration	Not significant	Moderately significant as site is away from residential areas and construction machinery will be applied within the plant premises	Not Significant	• The noise level of machines used during construction will be controlled as far as possible and workers will be provided with muffs wherever the noise level [illegible] dB(A). • The speed of vehicles used for transportation of construction machinery and [illegible] be limited. • Installation of noise producing machinery in thick walled structures to control escaping noise during operational phase if required. • Regular monitoring of the ambient noise for compliance of NEQS for noise. • Existence the population at distance [illegible] or more
Aesthetic resources			Smoke and building design may change scenic value of agricultural area	Control of smoke color through [illegible] design of the plant matching with [illegible] fields.
Biological Environment				

Flora	Not significant	Not significant as no flora except crops exist there	Unabated emissions of PM may lead to damage of crops and around the plant	Control of PM below NEQS and WHO guidelines will make the effect insignificant
Fauna	Not significant	Not significant	Significant if air and water pollution is emitted uncontrolled	Air and water emissions will be controlled to remain within permissible limits by treatment, therefore effect is insignificant.
Aquatic species	Not significant	No aquatic species	Not significant	Not required
Threatened and endangered species	Shisham is threatened species at area	Nill	Not significant	Shisham tree will be planted after completion of the project to encourage the species in area.
Protected areas	Not significant	No protected area exist at site	No protected area exists near the site	Not significant

subject	Environmental and social Impacts During Project Phases			Proposed Mitigation Measures
	Planning	Construction	Operation	
Environmental Impacts				
Occupational Health	Not significant	Significant	Significant	Assignment of specific

and Safety			handling of bagasse	Quality& EHS at proposed plant • Regular Health Checkups for workers bagasse. • Training of staff. • Mandatory use of protective clothing • Compliance of National and International (OHSAS) requirements for safety of workers
Emergency Procedure and Contingency Plans	Not significant	Significant	Significant	• Preparation and Implementation Emergency response manual. • Training on health and safety issues hired professionals and contractors the factory. • Presence of first aid facility at site • Medical facilities of M.Garh and Multan will be availed in case of any accident • Firefighting equipment and hydrants at risky places.
Fuel storage	Nil	Leakage of oils or diesel may contaminate soil	Not significant	Fuel storage during construction will be done at designated and controlled area

Subject	Environmental and social Impacts During Project Phases	Proposed Mitigation Measures

	Planning	Construction	Operation	
Environmental Impacts				
Air	Nil	Significant due to movement of construction material trucks during cane crushing season.	Not significant	• Construction will be carried out in sugar cane off season. • Security and safety guards will be provided at the check posts. • Installation of necessary signs and symbols at appropriate locations. • Check on exhaust smoke density and speed of vehicles to control noise and air pollution. • Concreting the roads for movement of trucks and lorries. • Enough space for parking in the plant.
Fire Protection	Not significant	Not significant	Significant due to piling and handling of bagasse	Mitigated through: • Firefighting system will be provided which consists of the following: • Underground fire service mains and valve pits. • Hydrants and fire water monitors. • Fire extinguishers (water type,

				clean agent, foam and dr • Fire brigade and firefighting • Fire fighting ambulance • Contact numbers of Garh and Kot Addu

Table [illegible] Summary of Environmental Monitoring Plan

Environmental Impact	Responsible Person /Section	Monitoring plan
Socio-Economic	[illegible] Head and proponent of the power plant	Monitoring of socio-economic activities by developing a close liaison with the communities in the area through the local consultative group.
Air Quality	GM and Manager EHS through a) plant Laboratory and Environment officer b) EPD Laboratory c) [illegible]ertified labs.	Monitoring of CO, NOx, PM10, SO2, in plant premises on quaterly basis or as required by environmental monitoring agency (EPA).
Treated Waste water effluent	[illegible]l Manager power plant and Environment, health and safety officer.	He will ensure the appropriate design and technology of Power plant. Manager EHS will manage monitoring of treated effluents with required frequency form environmental certified lab
Data and record keeping	Environment officer	The data of monitoring will be well documented. Copy of all NEQS, PEPA, 2012 and all rules and regulations will be kept in record for consultation
Wastewater/ Sanitary wastewater	Plant Engineer and O&M Staff through [illegible]t Laboratory [illegible]rtified labs or EPD	Checking of influent and final treated effluent quality for parameters of BOD, COD, and TDS. In addition heavy metals will be checked on quarterly basis
Noise	[illegible]ment Officer [illegible]t Laboratory [illegible]rtified labs.	Quarterly monitoring of noise levels in the vicinity of main plant components and on the plant periphery and reporting to EPD.
Medical Examination	[illegible]al officer	Pre-employment and yearly medical examination of all the workers especially working near bagasse handling.
Tree Plantation	[illegible] head and S[illegible] officer.	Tree Plantation will be ensured for prescribed variety.
Ash generation testing and disposal	[illegible] Officer EHS	Ash will be properly stored dried and disposed in environment friendly manner and reused as soil conditioner in the people of the area.

Safety plans, emergency plans

INFORMATION FOR CHECK LIST

Sl.No.	Description	Detail
3(5)(g)(a)	The type, technology, model, technical details and design of the facilities proposed to be acquired, constructed, developed or installed	Boiler - Travelling grate type, Bagasse fired Boiler of capacity 150 TPH with steam outlet parameters of 110 Bar(a) and 540 Deg.C TG - Double extraction cum condensing TG with water cooled condenser of capacity 30 MW.
Schedule III		
2	Technology, size of plant , number of units	1 No. of unit of 30 MW.
4	Emission values	SOx (mg/Nm3) - 412 NOx (mg/Nm3) - Less than 80 ppm CO2 - NIL CO (mg/Nm3) - NIL PM - 50 mg/Nm3
5	Cooling water source tube wells, sea, river, canal distance from source etc.	RCC counter flow cooling tower of capacity 6800 Cu.M/Hr
11	Safety plans, emergency plans	High velcoity spray system shall be installed in Bagasse storage area, Transformers and switchyard.
13	Plant characteristics: generation voltage, power factor, frequency, automatic generation control, ramping rate, control metering and instrumentation	Generation Voltage - 11000 Volts Frequency - 50 Hz Power Factor - 0.8 (lag) Automatic Generation (AGC)- Through Woodward Control Governor Ramping Rate & time required to synchronize to grid - i. During Hot start – 53 minutes - ii. During Warm start – 80 minutes - iii. During cold start – 130 minutes (If turbine is started within 72 hours after shutdown) - iv. During Cold start – 150 minutes (If turbine is started later than 72 hours after shutdown)

14	Control, metering, instrumentation and protection	Refer the following enclosed drawings: a. Protection, Metering & Control schematic diagram for 11kV & 132kV System (Drg. No. 0-15212-900-0462, Rev-0) b. Overall Key Single line diagram (Drg. No. 1-15212-900-0463, Rev-0)

Safety Plan

To provide a safe working environment, the company shall follow a well devised safety plan.

Key features of safety plan are given below:

Awareness

Staff working at the facility shall be given information to help them to identify the risks and take necessary measures of safety and protection during their working. To create awareness, personnel at the facility shall be briefed through handouts, in-house seminars, mock safety drills. Particular areas of interest shall be:

- Moral Obligation
- Hazard Recognition
- Importance of Personnel Protective Equipment (PPEs)
- Accident Prevention
- Importance of House Keeping
- Machine Guarding
- Fire Prevention
- Fire Protection
- Fire Fighting

Use of Safety Equipment

Use of Personal protective equipment (PPEs) will be made mandatory. PPEs like safety helmet, safety shoes, uniform, dust mask, ear plugs, ear muff, leather apron, leather sleeves, face shield, gloves for their safety shall be issued to all personnel.

Emergency Alarms

Automatic Emergency Alarms shall be installed along with fire suppression system at all fire hazardous locations of the plant site.

Emergency Numbers

Emergency call numbers shall prominently be displayed in bold at prominent places in the facility.

Emergency Shutdown

The Emergency response Team shall be responsible to ensure immediate shutdown of the operational systems and equipment if required in the Emergency.

First Aid Facilities

The availability of first aid facilities and necessary staff to provide urgent and immediate first aid facilities will be ensured at the facility.

Ambulances

Availability of Ambulance at the facility shall be ensured for causality evacuation to the hospitals.

Mock Fire Drills

To keep fire brigade staff in good practice, mock fire drill will be executed by creating mock emergency situations.

Fire Fighting System

The fire protection system will be provided for early detection, alarm, containment and suppression of fire. A comprehensive fire protection system has been planned to meet the above objective. A multitude system shall be provided to combat various types of fire 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.

The complete fire protection system shall comprise of following;

- Stand pipe & hose system for building and structure (internal)
- Yard main, hydrants and monitors of plant site (external)
- Fire alarm and signaling
- Portable fire extinguishers • Water spray fixed systems

The system shall be designed generally as per NFPA (National Fire Protection Association) standards.

EMERGENCY PLAN

A comprehensive emergency plan would be implemented to meet unexpected situation to ensure zero injury, damage or loss of any life/property.

Key features of the emergency plan are as follows;

Emergency Escapes/Evacuation Plan

A comprehensive evacuation plan will be prepared and emergency escape procedure and route maps will be displayed at prominent places in the facility. All personnel at the facility shall be made aware of Emergency escape routes and procedures for a quick and safe escape.

Awareness of Different Types of Emergencies

All personnel at the facility shall be educated on how to react to each type of emergency. All staff working at the facility will be given detailed briefing regarding different types of emergencies and their response so that they would be able to identify emergency situations.

Training to React to an Emergency Alert Alarm

All personnel at the facility shall be trained to react to each emergency to take necessary measures of safety and protection at the earliest.

Emergency Equipment

In addition to emergency combatants training, emergency equipment like fire extinguishers and fire hydrants will be provided at the facility to tackle with different types of Emergency.

Use of Safety Gears and Equipment

The staff working at the facility will be given with proper information, guidance and training about the use the safety gears and equipment.

Emergency Alarm

Easy access to emergency alarms shall be provided to raise the alarm in case of any type of Emergency.

Emergency Numbers

Emergency call numbers shall prominently be displayed at prominent places in the facility.

Emergency Response Team

A well-equipped and specialized team will be formed which will be responsible to take all necessary measures and decisions to deal with the emergency and provide relief, support and first aid to the effected staff. The emergency response team will also be responsible for the evacuation of personnel and material from the premises.

Emergency Shutdown

The Emergency response Team shall be responsible to ensure immediate shutdown of the operational systems and equipment if required in the Emergency.

Assembly Areas and Muster Points.

Designated assembly areas / Muster points shall be identified and all personnel working at the facility will be educated to muster at the designated assembly area / muster points in the event of an evacuation for head count.

Ambulances

Availability of Ambulance at the facility shall be ensured for causality evacuation to the hospitals.

System studies, load flow, short circuit, stability, reliability

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Office of the
Chief Executive
MEPCO Ltd, Multan

Memo No. 16309-12/C.E (P&E) Dated 20 FEB 2016

CHIEF ENGINEER/C.S DIRECTOR
MEPCO Ltd. MULTAN

SUB: - **Electrical Grid Studies for 30MW, Bagasse Based Thermal Power Project by Sheikhoo Power (Pvt.) Limited at Muzaffargarh, Punjab, Pakistan**

Ref: - **Chief Engineer/C.S. Director Letter No. 628/CE/MEPCO/CSD/D (MKT)/PP-103/SSML/10326-28 dated February 06, 2016**

The Draft Grid Interconnection Study (GIS) report for 30MW, Bagasse Based Thermal Power Project by Sheikhoo Power (Pvt.) Limited at Muzaffargarh, Punjab, Pakistan have been received vide above subjected letters. After reviewing the said study, the following observations were pointed out:

- In future peak load case (September 2021), there is capacity constraint in the area of Sheikhoo PP. The transmission line from KAPCO - Gujrat South - Muzaffar Garh-Old became overloaded; when transmission line from Sheikhoo PP to Muzaffar Garh- Old is switched off (N-1 contingency).
- In order to ensure reliable power evacuation and to solve problem of overloading during N-1 contingency, Consultant has proposed **"Re-conductoring of existing SC transmission line from KAPCO-Gujrat South-Muzaffar Garh-Old from LYNX to Rail conductor and stringing of second circuit on Rail on same circuit towers".**
- Moreover, in the future year 2021, the consultant has also recommended change in T-Off (Junction) point (Annex-A), which would result into feeding 132 KV Industrial Estate only from 220/132 KV Muzaffargarh Grid Station and its direct connection from 220/132 KV KAPCO Grid Station will be lost.

In light of above mentioned proposed reinforcements, it is therefore requested to obtain opinion of CE (T&G) and CE (Dev.) regarding the practical implementation, timeline and its feasibility (ROW) in order to proceed further in this matter.

Chief Engineer (P&E)
MEPCO Ltd, Multan

CC :

I. Chief Engineer (Dev.), MEPCO Ltd. Multan
II. Executive Director, Sheikhoo Power (Pvt.) Limited. F-11, Phase-I, Commercial Area, DHA, Lahore
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GRID INTERCONNECTION ASSESSMENT OF 30 MW BAGASSE BASED THERMAL POWER PLANT, KOT ADDU

ARCO Energy

Draft Report
September, 2016

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Annex F: Short Circuit Analysis Results.

Executive Summary

This Grid Interconnection Assessment (GIA) report provides the documentation of an assessment that has been performed for the connection of a 30 MW bagasse based thermal power plant by Sheikhoo Power (Pvt.) Limited to the Multan Electric Power Company (MEPCO) power system at 132 kV. The project is located at Anwarabad, Tehsil Kot Addu, district Muzaffargarh, Punjab, Pakistan and has a commercial operation date of September, 2018. GIA includes the following three types of analyses: i) steady state analysis, ii) dynamic stability analysis and, iii) short circuit analysis. The project will be connected with the grid system of MEPCO by making 0.5 km IN and 0.5 km OUT double circuit 132 kV transmission line of Lynx conductor, from KAPCO to Muzaffargarh.

Gross capacity of the power plant is 30 MW and the available net power to be injected into the MEPCO system is given below.

Description	Total Capacity Gross (MW)	Plant Auxiliary Load (MW)	Net Available Power (MW)
During Season	30	9	21
During Off-Season	30	4	26

Steady state power flow assessment has been performed for September 2018 and January 2019 peak load conditions, using the MEPCO system data provided by MEPCO. Pre project power flow study was conducted to analyze the magnitude and phase angle of bus voltages, line loadings and power flows under steady-state conditions. Post project power flow analysis has also been performed after the interconnection of the proposed project with the MEPCO transmission system. The power flow results for the system intact and for the contingency conditions shows that the power flows on all the transmission line branches are within their normal thermal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

Dynamic stability analysis has been performed to access the dynamic impact of the thermal power plant on national grid system due to disturbances at the power plant and vice versa. The results of dynamic stability analysis show that the power system is stable for the interconnection scheme and it also fulfils all the criteria for generation connection with the power system.

Short circuit analysis has been performed to evaluate the impact of the proposed project on fault current level at substations in the electrical vicinity of the proposed thermal power plant. Fault currents have been computed based on simulation of three-phase and single-line-to-ground

faults by applying the criteria as mentioned in the IEC-909 standard. Results of the analysis show that the calculated fault currents are below circuit-breaker interrupting ratings.

Based on the study results, it is concluded that proposed generation interconnection assessment for 30 MW bagasse based thermal power plant meets the NEPRA grid code planning criteria.

1 Introduction

1.1 Project Description

This Grid Interconnection Assessment (GIA) report provides the documentation of an assessment that has been performed by ARCO Energy in response to a request made by Sheikhoo Power (Pvt.) Limited (the "Project Owner" or "PO") for the connection of a 30 MW bagasse based thermal power plant ("Project") to the Multan Electric Power Company (MEPCO) power system at 132 kV. The PO has proposed a commercial operation date of September, 2018 for the project.

The project is located at Anwarabad, Tehsil Kot Addu, district Muzaffargarh, Punjab, Pakistan. Figure 1.1 shows google site map of the project.

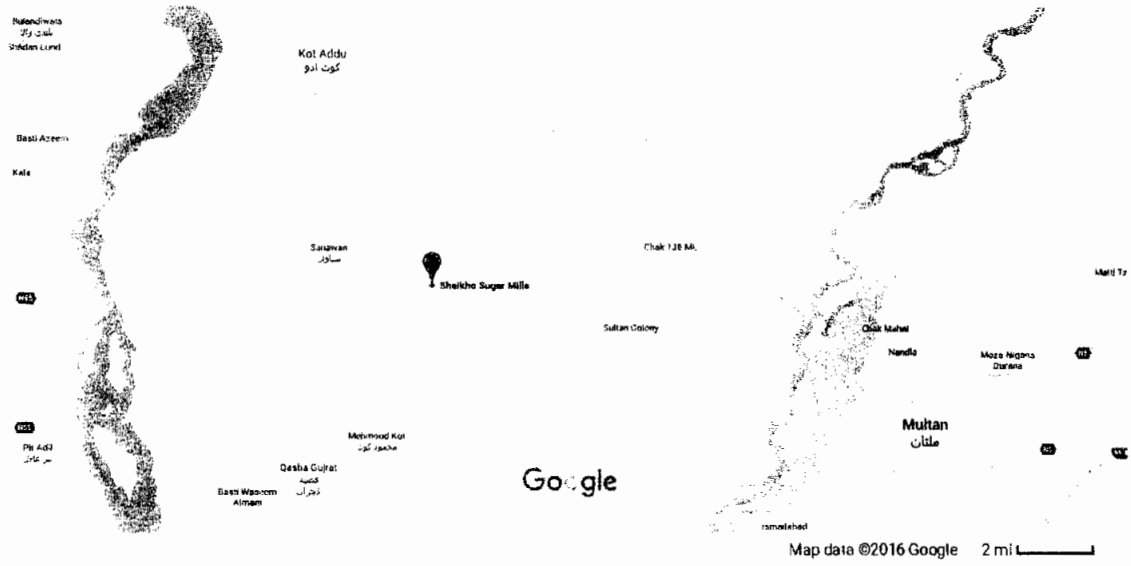

Figure 1.1: Google site map of the project

Gross capacity of the power plant is 30 MW and the available net power to be injected into the MEPCO system is given below.

Description	Total Capacity Gross (MW)	Plant Auxiliary Load (MW)	Net Available Power (MW)
During Season	30	9	21
During Off-Season	30	4	26

1.2 Grid Interconnection Arrangement

The project will be connected with the grid system of MEPCO by making 0.5 km IN and 0.5 km OUT double circuit 132 kV transmission line of Lynx conductor, from KAPCO to

Muzaffargarh. The objective of the GIA is to evaluate the impact of the proposed thermal power plant on the MEPCO power system.

The MEPCO power system network data (generation plan of NTDC, transmission plan of NTDC and load forecast of Disco's & NTDC) is attached as Annexure-B.

1.3 Study Components

This GIA includes the following three types of analyses to evaluate the impact of interconnecting the proposed project: i) steady state analysis, ii) dynamic stability analysis and, iii) short circuit analysis.

This report documents the results of the steady state, dynamic stability and the short circuit analyses. The steady state analysis includes pre project and post project power flow assessment. Dynamic stability analysis includes the post project dynamic stability assessment. Short circuit analysis includes pre project and post project short circuit current levels assessment at different buses in the vicinity of the project.

2 Study Methodology

2.1 Study Criteria

GIA has been carried out based on the National Electric Power Regulatory Authority (NEPRA) Grid Code planning criteria. Key parameters and their corresponding limits have been summarized in table below.

Parameter		Range
Voltage	System Intact	±5 % pu
	Contingency	±10 % pu
Thermal loading	System Intact	100%
	Contingency	100%
Frequency	Nominal	50 Hz
	Steady State Variation	49.8 Hz - 50.2 Hz
	Contingency Band	49.4 Hz - 50.5 Hz
Power Factor	Lagging	0.80
	Leading	0.9
Breaker Short Circuit Rating	132 kV	40kA
	11 kV	25kA

2.2 Steady State Analysis

The purpose of steady-state analysis is to analyse the impact of the proposed thermal power plant on transmission system facilities under steady-state conditions. It involves two distinct analyses: thermal loading analysis and voltage analysis. Power flow solutions using the PSS/E® program (Version 32) has been performed.

A "study area" was defined to represent the areas of interest which includes the following substations within MEPCO:

- KAPCO
- Muzaffargarh
- Gujrat South
- Killa Bagha Sher
- Kot Addu Old
- Muzaffargarh New
- Mln-Ind
- Fatma Energy

Thermal Loading Analysis

Transmission facilities rated 132 kV in the study area have been monitored.

System Intact Analysis

The incremental impact of the project on thermal loading of transmission facilities under system intact conditions was evaluated by comparing transmission system power flows without and with the proposed project. Overloaded transmission facility loadings without and with the project were tabulated and compared. The criteria to flag thermal overloads are 100% of continuous facility rating (Rate A in the power flow model).

Contingency Analysis

The contingency analysis for this study consists of single branch outage of 132 kV in the study area.

Voltage Analysis

Voltages at buses inside the study area have been monitored for possible pre and post project voltage violations in accordance with NEPRA Grid Code guidelines. In accordance with these guidelines, those buses that have a voltage change of more than ±5% pu (System Intact condition) and ±10% pu (contingency condition) are considered affected.

2.3 Dynamic Stability Analysis

The purpose of dynamic stability analysis is to analyse the impact of the proposed thermal power plant on transmission system facilities under dynamic conditions. The system is considered to be stable if the system recovers with good damping after the transients die out and the synchronism is retained.

Fault clearing time for different voltage levels in accordance with NEPRA Grid Code guidelines is presented in table below.

Voltage Level	Fault Clearing Time
132 kV	5 Cycles (100 msec)
132 kV(Stuck Breaker)	9 Cycles (180 msec)

2.4 Short Circuit Analysis

The purpose of short-circuit analysis is to investigate the fault current levels at nearby substations with the proposed project online. And to check whether the calculated post-project fault currents are within circuit breaker interrupting ratings. Short circuit analysis has been carried by applying the criteria as mentioned in the IEC-909 standard. Key assumptions in IEC-909 are given below.

- Tap ratios to unity
- Line charging to zero

- shunts are set to zero in positive sequence
- Desired voltage magnitude at bus bars is set to 1.1 pu

3 Steady State Analysis

3.1 Model Development

Project specific data was provided by the plant owner and it has been compiled and presented in Annexure-A. The steady state model of the power plant and the switch yard is presented in table below;

	Generator Data
Generator size (MVA)	37.50
Active Power Pgen. (MW)	30
Power Factor	0.8 lagging, 0.9 leading
Qmin, Qmax (MVAR)	-15.034, 22.5
Rated Frequency	50 Hz
Generation Voltage	11 kV
Xsource	0.25 pu
Generation Step Up (GSU) Transformer	
Rating	11/132 kV, 40 MVA
No. of Transformer	1
Reactance (X)	0.46 p.u.

Gross capacity of the power plant is 30 MW and the available net power to be injected into the MEPCO system will be 21 MW during season and 26 MW during Off-Season, remaining is the auxiliary consumption.

3.2 Pre Project Power Flow Assessment

A pre project power flow study was conducted to analyze the magnitude and phase angles of bus voltages, line loadings and power flows under steady-state conditions.

3.2.1 Base Year: Summer 2018

Power flow analysis has been performed for September 2018 peak load conditions, using the MEPCO system data provided by MEPCO (Annexure-B). This base case included a detailed representation of the MEPCO power system in the study area.

The power flow results for the system intact conditions show that the power flows on all the transmission line branches are within their normal thermal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area. The results of the pre project power flow analysis are plotted in **Annexure-C**.

3.3 Post Project Power Flow Assessment

Post project power flow study was conducted to determine the reliability impact of the proposed 30 MW bagasse based thermal power plant project on the MEPCO power system. This includes the performance of a contingency analysis to identify any facility overload or voltage condition that violates the NEPRA planning criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report with a least cost plan identified to mitigate them.

3.3.1 Base Year: Summer 2018

A base case has been developed for September 2018 peak load conditions that allow us to judge the maximum impact of Sheikhoo power plant on the MEPCO network.

Post project power flow analysis has been performed after the interconnection of the proposed project with the MEPCO power system. This includes the detailed representation of the power plant and its switchyard. A simulation of all possible contingencies within the NEPRA Grid Code planning criteria has also been carried out.

The power flow results for the system intact and for the contingency conditions show that the power flows on all the transmission line branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area. Results from the power flow analysis are presented in table below.

The results of the post project power flow analysis are plotted in **Annexure-D**

Condition	Contingent Branch	Figure No.	Steady State Result
System Intact	N.A.	Figure D-1	No overloading
Contingency	SHK Power Plant to KAPCO line out	Figure D-1.1	No overloading
	SHK Power Plant to Muzaffargarh line out	Figure D-1.2	No overloading
	Gujrat south to KAPCO line out	Figure D-1.3	No overloading
	Gujrat south to Muzaffargarh line out	Figure D-1.4	No overloading
	KAPCO to Killa Bagha Sher line out	Figure D-1.5	No overloading
	KAPCO to Kotaddu Old line out	Figure D-1.6	No overloading
	Muzaffargarh to Muzaffargarh-New line out	Figure D-1.7	No overloading
	Muzaffargarh to Mln-Ind line out	Figure D-1.8	No overloading
	Muzaffargarh-New to Fatima Energy line out	Figure D-1.9	No overloading

3.3.2 Base Year: Winter 2019

A base case has been developed for January 2019 peak load conditions that allow us to judge the maximum impact of Sheikhoo power plant on the MEPCO network.

Post project power flow analysis has been performed after the interconnection of the proposed project with the MEPCO power system. This includes the detailed representation of the power plant and its switchyard. A simulation of all possible contingencies within the NEPRA Grid Code planning criteria has also been carried out.

Power flow results for the system intact and for the contingency conditions show that the power flows on all the transmission line branches are within their normal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area. Results from the power flow analysis are presented in table below.

The results of the post project power flow analysis are plotted in **Annexure-D**.

Condition	Contingent Branch	Figure No.	Steady State Result
System Intact	N.A.	Figure D-2	No overloading
Contingency	SHK Power Plant to KAPCO line out	Figure D-2.1	No overloading
	SHK Power Plant to Muzaffargarh line out	Figure D-2.2	No overloading
	Gujrat south to KAPCO line out	Figure D-2.3	No overloading
	Gujrat south to Muzaffargarh line out	Figure D-2.4	No overloading
	KAPCO to Killa Bagha Sher line out	Figure D-2.5	No overloading
	KAPCO to Kotaddu Old line out	Figure D-2.6	No overloading
	Muzaffargarh to Muzaffargarh-New line out	Figure D-2.7	No overloading
	Muzaffargarh to Mln-Ind line out	Figure D-2.8	No overloading
	Muzaffargarh-New to Fatima Energy line out	Figure D-2.9	No overloading

4 Dynamic Stability Analysis

Dynamic stability analysis has been performed to access the dynamic impact of the thermal power plant on national grid system due to disturbances at the power plant and vice versa.

4.1 Dynamic Model Development

Generic dynamic models, available in the PSSE model library, for the thermal power plant have been used to develop the dynamic model of the power plant. Dynamic model of the power plant is presented in table below;

Component	Model
Generator	GENROU
Excitation System	IEEET1
Speed Governing System	TGOV1

4.2 Post Project Dynamic Stability Assessment

4.2.1 Base Year: 2018

Dynamic stability analysis has been carried out for the base year 2018 conditions. To access the dynamic behavior of power plant and system towards the disturbances, simulations have been carried out for the following faults:

i. 3 Phase fault at SHK PP 132 kV bus cleared in 5 cycles.
ii. 3 Phase fault at KAPCO 132 kV bus cleared in 5 cycles.
iii. 3 Phase fault at Muzaffargarh 132 kV bus cleared in 5 cycles
iv. 3 Phase fault at SHK PP 132 kV bus cleared in 9 cycles (Stuck Breaker).
v. 3 Phase faults at KAPCO 132 kV bus cleared in 9 cycles (stuck breaker).
vi. 3 Phase faults at Muzaffargarh 132 kV bus cleared in 9 cycles (stuck breaker).

Each simulation has been performed for one second to depict steady state condition. Then fault is applied and system has been simulated for the fault clearance time. Post-fault condition has been simulated, from clearance of fault followed by a certain contingency, till ten seconds.

4.2.2 3 Phase fault at SHK PP 132 kV bus cleared in 5 cycles

Three phase fault has been applied at Sheikhoo power plant, fault has been cleared in 100 msec (5 cycles) with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-1: 3 Phase fault at SHK PP 132 kV bus cleared in 5 cycles (Standard Opening in 100 msec)

No.	Contingency	Monitored Element	Figure No.	System Response
E-1.1	132kV line from SHK-PP to KAPCO	Bus Voltages of 11 kV SHK-PP, 132 kV SHK-PP, KAPCO, Muzaffargarh and Gujrat South	E-1.1A	Stable
		Frequency at 11kV SHK-PP	E-1.1B	Stable
		MW and MVAR of SHK-PP	E-1.1C	Stable
		Rotor Angles of SHK-PP, KAPCO and Fatma Energy w.r.t. HUBCO Slack Bus	E-1.1D	Stable
		MW and MVAR flows at 132kV line from SHK PP to Muzaffargarh	E-1.1E	Stable
E-1.2	132kV line from SHK-PP to Muzaffargarh	Bus Voltages of 11 kV SHK-PP, 132 kV SHK-PP, KAPCO, Muzaffargarh, Gujrat South	E-1.2A	Stable
		Frequency at 11kV SHK-PP	E-1.2B	Stable
		MW and MVAR of SHK-PP	E-1.2C	Stable
		Rotot Angles of SHK-PP, KAPCO and Fatma Energy w.r.t. HUBCO Slack Bus	E-1.2D	Stable
		MW and MVAR flows at 132kV line from SHK PP to KAPCO	E-1.2E	Stable

4.2.3 3 Phase fault at KAPCO 132 kV bus cleared in 5 cycles

Three phase fault has been applied at KAPCO 132 kV bus, fault has been cleared in 100 msec (5 cycles) with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-2: 3 Phase fault at KAPCO 132 kV bus cleared in 5 cycles (Standard Opening in 100 msec)

No.	Contingency	Monitored Element	Figure No.	System Response
E-2.1	132kV line from SHK-PP to KAPCO,	Bus Voltages of 11 kV SHK-PP, 132 kV SHK-PP, KAPCO, Muzaffargarh and Gujrat South	E-2.1A	Stable
		Frequency at 11kV SHK-PP	E-2.1B	Stable
		MW and MVAR of SHK-PP	E-2.1C	Stable
		Rotor Angles of SHK-PP, KAPCO and Fatma Energy w.r.t. HUBCO Slack Bus	E-2.1D	Stable
		MW and MVAR flows at 132kV line from SHK PP to Muzaffargarh	E-2.1E	Stable

4.2.4 3 Phase fault at Muzaffargarh 132 kV bus cleared in 5 cycles

Three phase fault has been applied at Muzaffargarh 132 kV bus, fault has been cleared in 100 msec (5 cycles) with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-3: 3 Phase fault at Muzaffargarh 132 kV bus cleared in 5 cycles (Standard Opening in 100 msec)

No.	Contingency	Monitored Element	Figure No.	System Response
E-3.1	132kV line from SHK-PP to Muzaffargarh	Bus Voltages of 11 kV SHK-PP, 132 kV SHK-PP, KAPCO, Muzaffargarh and Gujrat South	E-3.1A	Stable
		Frequency at 11kV SHK-PP	E-3.1B	Stable
		MW and MVAR of SHK-PP	E-3.1C	Stable
		Rotor Angles of SHK-PP, KAPCO and Fatma Energy w.r.t. HUBCO Slack Bus	E-3.1D	Stable
		MW and MVAR flows at 132kV line from SHK PP to KAPCO	E-3.1E	Stable

4.2.5 3 Phase fault at SHK PP 132 kV bus cleared in 9 cycles (Stuck Breaker)

Three phase fault has been applied at Sheikhoo power plant. Fault has been cleared in 180 msec (9 cycles) to depict stuck breaker conditions with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below:

Fault E-4: 3 Phase fault at SHK PP 132 kV bus cleared in 9 cycles (Stuck Breaker Opening in 180 msec)

No.	Contingency	Monitored Element	Figure No.	System Response
E-4.1	132kV line from SHK-PP to KAPCO	Bus Voltages of 11 kV SHK-PP, 132 kV SHK-PP, KAPCO, Muzaffargarh and Gujrat South	E-4.1A	Stable
		Frequency at 11kV SHK-PP	E-4.1B	Stable
		MW and MVAR of SHK-PP	E-4.1C	Stable
		Rotor Angles of SHK-PP, KAPCO and Fatma Energy w.r.t. HUBCO Slack Bus	E-4.1D	Stable
		MW and MVAR flows at 132kV line from SHK PP to Muzaffargarh	E-4.1E	Stable
E-4.2	132kV line from SHK-PP to Muzaffargarh	Bus Voltages of 11 kV SHK-PP, 132 kV SHK-PP, KAPCO, Muzaffargarh and Gujrat South	E-4.2A	Stable
		Frequency at 11kV SHK-PP	E-4.2B	Stable
		MW and MVAR of SHK-PP	E-4.2C	Stable

No.	Contingency	Monitored Element	Figure No.	System Response
		Rotor Angles of SHK-PP, KAPCO and Fatma Energy w.r.t. HUBCO Slack Bus	E-4.2D	Stable
		MW and MVAR flows at 132kV line from SHK PP to KAPCO	E-4.2E	Stable

4.2.6 3 Phase fault at KAPCO 132 kV bus cleared in 9 cycles (Stuck Breaker)

Three phase fault has been applied at KAPCO 132 kV bus. Fault has been cleared in 180 msec (9 cycles) to depict stuck breaker conditions with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-5: 3 Phase faults at KAPCO 132 kV bus cleared in 9 cycles (Stuck Breaker Opening in 180 msec).

No.	Contingency	Monitored Element	Figure No.	System Response
E-5.1	132kV line from SHK-PP to KAPCO	Bus Voltages of 11 kV SHK-PP, 132 kV SHK-PP, KAPCO, Muzaffargarh and Gujrat South	E-5.1A	Stable
		Frequency at 11kV SHK-PP	E-5.1B	Stable
		MW and MVAR of SHK-PP	E-5.1C	Stable
		Rotor Angles of SHK-PP, KAPCO and Fatma Energy w.r.t. HUBCO Slack Bus	E-5.1D	Stable
		MW and MVAR flows at 132kV line from SHK PP to Muzaffargarh	E-5.1E	Stable

4.2.7 3 Phase fault at Muzaffargarh 132 kV bus cleared in 9 cycles (Stuck Breaker)

Three phase fault has been applied at Muzaffargarh 132kV bus. Fault has been cleared in 180 msec (9 cycles) to depict stuck breaker conditions with a particular N-1 contingency and dynamic stability response of the system is monitored, the same has been summarized in the table below.

Fault E-6: 3 Phase faults at Muzaffargarh 132 kV bus cleared in 9 cycles (Stuck Breaker Opening in 180 msec).

No.	Contingency	Monitored Element	Figure No.	System Response
E-6.1	132kV line from SHK-PP to Muzaffargarh	Bus Voltages of 11 kV SHK-PP, 132 kV SHK-PP, KAPCO, Muzaffargarh and Gujrat South	E-6.1A	Stable
		Frequency at 11kV SHK-PP	E-6.1B	Stable
		MW and MVAR of SHK-PP	E-6.1C	Stable

No.	Contingency	Monitored Element	Figure No.	System Response
		Rotor Angles of SHK-PP, KAPCO and Fatma Energy w.r.t. HUBCO Slack Bus	E-6.1D	Stable
		MW and MVAR flows at 132kV line from SHK PP to KAPCO	E-6.1E	Stable

Dynamic stability analysis results are attached in **Annexure-E**.

5 Short Circuit Analysis

Short circuit analysis has been performed to determine the need for any breaker replacements due to impacts of the thermal power plant project. Single-line-to-ground and three-phase fault current values have been calculated for buses in the vicinity of the thermal power plant project. The calculated fault currents observed at these buses were compared with the interrupting current capabilities of corresponding circuit breakers to determine need for upgrading existing circuit breakers. Short circuit assessment has also been done on the bus of the thermal power plant project.

5.1 Short Circuit Model Development

Short circuit database of MEPCO as already available has been used as a base case to perform short circuit assessment. The study project has been added to the base case to develop the post-project case. The short circuit model of the power plant and the switch yard is presented in table below.

Generator Data	
X (+ve)	0.25 pu
X (-ve)	0.25 pu
X (zero)	0.25 pu

5.2 Post Project Short Circuit Assessment

With the addition of power plant, short circuit current at each bur bar is increased, so the circuit breaker capacity has analysed. Post project short circuit assessment has been performed to evaluate the short circuit levels on the bus of the thermal power plant project.

5.2.1 Maximum Short Circuit: Future Year 2021

The maximum short circuit levels have been computed according to IEC-909 standard. Post project maximum short circuit levels at the buses within the study area in the future year 2021 have been presented in table below.

Bus Name	Bus kV	1-Φ Fault Level (kA)	3-Φ Fault Level (kA)
SHK Power Plant	11	21.249	14.739
SHK Power Plant	132	13.572	10.219
KAPCO	132	38.751	43.799
Muzaffargarh	132	25.822	23.417
Killa Bagha Sher	132	11.947	8.558
Mln-Ind	132	22.367	13.236
Fatma Energy	132	10.700	9.898

Bus Name	Bus kV	1-Φ Fault Level (kA)	3-Φ Fault Level (kA)
Gujrat South	132	11.698	8.053
Muzaffargarh New	132	25.846	23.654

Post project maximum short circuit analysis report of future year 2021 is attached in **Appendix F-1.**

Note:

In the attached short circuit study reports, both three phase and single phase fault currents with polar coordinates and detailed output showing contribution from adjoining sources (i.e. lines and transformers connected to the bus bar) to the fault currents are included.

6 Conclusion

6.1 Steady State Assessment

Power flow analysis has been performed for September 2018 and January 2019 peak load conditions. Pre project power flow study was conducted to analyze the magnitude and phase angles of bus voltages, line loadings, and power flows under steady-state conditions. Post project power flow analysis has also been performed after the interconnection of the proposed project with the MEPCO transmission system. The power flow results for the system intact and for the contingency conditions showed that the power flows on all the transmission line branches are within their normal thermal loading limit. There is no capacity constraint in terms of power flow or voltage ratings within the study area.

6.2 Dynamic Stability Assessment

Dynamic stability analysis has been performed to access the dynamic impact of the thermal power plant on national grid system due to disturbances at the power plant and vice versa. The results of dynamic stability analysis shows that the power system is stable for the interconnection scheme of the thermal power plant and it fulfils all the criteria for generation connection with the power system.

6.3 Short Circuit Assessment

Short circuit analysis has been performed to evaluate the impact of the proposed project on fault currents at substations in the electrical vicinity of the proposed thermal power plant. Fault currents have been computed based on simulation of three-phase and single-line-to-ground faults by applying the criteria as mentioned in the IEC-909 standard. Short circuit analysis has also been done on the bus of the thermal power plant. Results of the analysis show that the calculated fault currents are below circuit-breaker interrupting ratings.

Based on the study results, it is concluded that proposed generation interconnection assessment for 30 MW bagasse based thermal power plant meets the NEPRA grid code planning criteria.

List of Annexures

Annex A: Project Specific Data.

Annex A-1: Project Site Map.
Annex A-2: Generator Data.
Annex A-3: Single Line Diagram of Switchyard.

Annex B: Network Data.

Annex B-1: Transmission plan of NTDC
Annex B-2: Generation plan of NTDC
Annex B-3: Load Forecast of Disco's and NTDC.

Annex C: Pre-Project Steady State Analysis Results.
Figure C-1: Base Year 2018 - Peak loading summer in system intact conditions.

Annex D: Post-Project Steady State Analysis Results.

Figure D-1: Base Year 2018 - Peak loading summer in system intact conditions.
Figures D-1.1 to D-1.9: N-1 contingencies of base year peak loading summer.
Figure D-2: Base Year 2019 - Peak loading winter in system intact conditions.
Figures D-2.1 to D-2.9: N-1 contingencies of base year peak loading winter.

Annex E: Dynamic Stability Analysis Results.
Fault E-1: 3 Phase fault at SHK PP bus cleared in 5 cycles (Standard Opening in 100 msec).
Fault E-2: 3 Phase fault at KAPCO 132kV bus cleared in 5 cycles (Standard Opening in 100 msec).
Fault E-3: 3 Phase fault at Muzaffargarh 132kV bus cleared in 5 cycles (Standard Opening in 100 msec).
Fault E-4: 3 Phase faults at SHK PP bus cleared in 9 cycles (Stuck Breaker Opening in 180 msec).
Fault E-5: 3 Phase fault at KAPCO 132kV bus cleared in 9 cycles (Stuck Breaker Opening in 180 msec).
Fault E-6: 3 Phase fault at Muzaffargarh 132kV bus cleared in 9 cycles (Stuck Breaker Opening in 180 msec).

Annex F: Short Circuit Analysis Results.

Annex F-1: Post project maximum short circuit report of future year 2021.

Annexure-A

Project Specific Data