DIGRI-GEN LIMITED

Head Office:
48-J/1, Block-6, PECHS, Karachi
Tel: 021-34541195-98

Ref. No.DGL/NEPRA/

Dated: May _____, 2017

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

Subject: **Application for a new Generation License for 25 MW Cogeneration Power Project by M/s Digri-Gen Limited at Digri Sugar Mills Limited, Taluka Digri, District Mirpur Khas**

Dear Sir

I, Ahaidh Hassan Mohammad Javeri , CEO, being the authorized representative of M/S DIGRI-GEN LIMITED by virtue of Board Resolution dated 2nd May, 2017, hereby apply to National Electric Power Regulatory Authority for grant of Generation license to the M/S DIGRI-GEN LIMITED pursuant to section (3) 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 provision 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 Pay Order No. 01584233 dated 12/05/2017 in the sum of Rs.300,336/-, being the non-refundable license application fee calculated in accordance with the schedule II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, is also attached herewith.

We shall be pleased to provide any further information you may require.

ThankingYou.
For Digri-Gen Limited

(Ahaidh Hassan Mohammad Javeri)
CEO

DIGRI-GEN LIMITED

Head Office:
48-J/1, Block-6, PECHS, Karachi
Tel: 021-34541195-98

EXTRACT OF RESOLUTION PASSED BY THE BOARD OF DIRECTORS OF M/S DIGRI-GEN LIMITED, IN ITS MEETING HELD ON MAY 02, 2017 AT 11.00 A.M AT ITS REGISTERED OFFICE AT 46-J/1, BLOCK-6, PECHS KARACHI

RESOLVED That;

Ahaidh Hassan Mohammad Javeri , CEO of M/s Digri-Gen Limited (DGL) shall be authorized on behalf of M/s DGL to sign and submit application to National Electric Power Regulatory Authority (NEPRA) for grant of Generation License for 25 MW (Gross) Co-generation Power Plant by Digri-Gen Limited, located at Taluka Digri, District Mirpur Khas. He shall also be authorized to sign all required agreements/applications/documents which may be required by NEPRA for grant of Generation License.

Dated : **02.05.2017**

Plant Details

1. General Information

(i)	Applicant's Name	Digri-Gen Limited
(ii)	Registered Office	46-J/1, Block-6, PECHS, Karachi
(iii)	Plant Location	At Digri Sugar Mills Limited, Taluka Digri, District Mirpur Khas
(iv)	Type of Generation Facility	Bagasse fired Cogeneration Power Plant
(v)	Expected Commissioning/Commercial Operation Date	18months from Financial close
(vi)	Expected Life of the Facility from Commercial Operation/Commissioning	30 years (Minimum)
(vii)	Expected Remaining Useful Life of the Facility	30 years (Minimum)

2. Plant Configuration

(i)	Plant Size Installed Capacity (Gross ISO)	25 MW (Gross)
(ii)	Type of Technology	Cogeneration Power Plant with high pressure boiler and Steam Turbine
(iii)	Number of Units	One (1)
(iv)	Boiler	100 TPH approximately, High pressure 115 bar (a)
(v)	Steam Turbine	Steam Turbine - Extraction cum condensing type 25 MW.
(vi)	Installed Capacity	Power Generation: 25 MW (Season operation) 25 MW (Off-season operation)
(vii)	Auxiliary Consumption	10% approx.

(viii)	Designed Efficiency of the Plant (%)	Season = 25% Off-Season = 28%
(ix)	Gross Efficiency of power plant at Mean Site Conditions (%)	Season 26% = 26% Off-Season = 29%
(x)	Net Efficiency of Plant at Mean Site Conditions (%)	Season 24% = 25% Off Season = 28%
(xi)	Interconnection	07 km 132kV Transmission Line from proposed project site with 132 KV HESCO's 132kV Grid Station

3. Fuel / Raw Material Details

(i)	Primary Fuel	Bagasse
(ii)	Alternate Fuel	Bagasse/ biomass
(iii)	Fuel Source (Imported/Indigenous)	Indigenous
(iv)	Fuel Supplier	Digri Sugar Mills Limited/ from local market
(v)	Supply Arrangement	Through conveyor belts/loading trucks/tractor trolleys etc.,
(vi)	Sugarcane Crushing Capacity	7,000 TCD
(vii)	Bagasse Generation Capacity	2,100 Tons per day (TPD)
(viii)	Bagasse Storage Capacity	Bulk Storage
(ix)	Number of Storage Tanks	Not Applicable, Bagasse shall be stored in open yard

4. Emission Values

Emission values will remain in the limits prescribed by the National Environment Quality Standards (NEQs).

5. Cooling System

(i)	Cooling Water Source / Cycle	Deep Bore well water/ Cooling Towers

6. Plant Characteristics

(i)	Generation Voltage	11000 volts

(ii)	Frequency	50 Hz	
(iii)	Power Factor	0.8 Lagging, 0.95 Leading	
(iv)	Automatic Generation Control (AGC)	By Turbine Governing System	
(v)	Ramping Rate	10% of full load per minute (approx.)	
(vi)	Estimated Time Required to Synchronize to Grid.	During cold start (i.e. when plant is started later than 72 hours after shutdown)	600 minutes
		During warm start (i.e. when plant is started at less than 36 hours after shutdown)	200 minutes
		During Hot start (i.e. when plant is started at less than 12 hours after shutdown)	60 minutes

Note:
All the above figures are indicative in nature. The Net Capacity available for dispatch will be determined through procedure(s) contained in the Energy Purchase Agreement, Grid code or any other applicable document(s).

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CERTIFIED TRUE COPY OF CERTIFICATE OF INCORPORATION

A025180

SECP

SECURITIES AND EXCHANGE COMMISSION OF PAKISTAN

COMPANY REGISTRATION OFFICE, KARACHI

CERTIFICATE OF INCORPORATION

[Under section 16 (5) of the Companies Ordinance, 2016 (VI of 2016)]

Corporate Universal Identification No. **0104091**

I hereby certify that **DIGRI-GEN LIMITED** is this day incorporated under the Companies Ordinance, 2016 (VI of 2016) and that the company is limited by shares.

Given under my hand at Karachi this Eighth day of December, Two Thousand and Sixteen.

Incorporation fee Rs. 210,500/= only

(Kashif Mahmood)
Deputy Registrar of Companies
Karachi

THE COMPANIES ORDINANCE, 2016

(PUBLIC COMPANY LIMITED BY SHARES)

Memorandum of Association of

DIGRI-GEN LIMITED

1. The name of the Company is "DIGRI-GEN LIMITED."

2. The Registered Office of the Company will be situated in the Province of the Sindh.

3. (i) The principal line of business of the Company shall be to To set up and operate electric power generation project for generating and supply of electricity to sister concern. Companies / Branches. W.A.P.D.A., K-Electric, HESCO., SEPCO., and also supply to industries, cities, towns, buildings, streets, docks, markets, theaters, and all places both public and private.

(ii) Except for the businesses mentioned in sub clause (iii) hereunder, the company shall engage in all the lawful businesses and shall be authorized to take all necessary steps and actions in connection therewith and ancillary thereto.

(iii) Notwithstanding anything contained in the foregoing sub-clauses of this clause nothing contained herein shall be construed as empowering the Company to undertake or indulge, directly or indirectly in the business of a Banking Company, Non-banking Finance Company (Mutual Fund, Leasing, Investment Company, Investment Advisor, Real Estate Investment Trust management company, Housing Finance Company, Venture Capital Company, Discounting Services, Microfinance or Microcredit business), Insurance Business, Modaraba management company, Stock Brokerage business, forex, real estate business, managing agency, business of providing the services of security guards or any other business restricted under any law for the time being in force or as may be specified by the Commission.

(iv) It is hereby undertaken that the company shall not:

(a) engage in any of the business mentioned in sub-clause (iii) above or any unlawful operation;

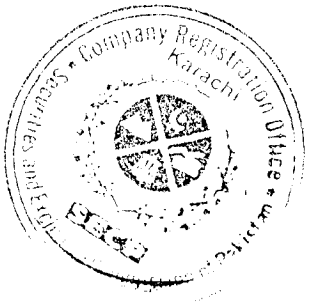
(b) launch multi-level marketing (MLM), Pyramid and Ponzi Schemes, or other related activities/businesses or any lottery business;

(c) engage in any of the permissible business unless the requisite approval,

permission, consent or licence is obtained from competent authority as may be required under any law for the time being in force.

4. The liability of the members is limited.

5. The authorised capital of the company is Rs. 50,000,000 - (Rupees Fifty million only) divided into 5,000,000 (Five million) ordinary shares of Rs. 10/- (Rupees Ten only) each with powers to increase and reduce the capital of the company and to divide the shares in the capital for the time being into several classes in accordance with the provisions of the Companies Ordinance, 2016.



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

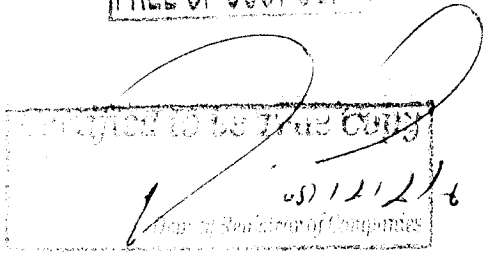
Name and Surname (Present and former, in full and block letters)	CNIC No.	Father's / husband Name	Nationality with any former Nationality	Occupation	Residential address in full	Number of shares taken by each subscriber	Signature
Ahaidh Hassan Mohammad Javeri	42301-3898307-5	S/o. Naveed Mohammad Javeri	Pakistani	Business	House D-195, Block-5, Clifton, Karachi	01 (One)	
Mira Hilla Ayesha Javeri	42301-6067953-4	D/o. Naveed Mohammad Javeri	Pakistani	Business	House D-195, Block-5, Clifton, Karachi	01 (One)	
Muhammad Ali Jamal	42301-5689797-5	S/o. Jamal Rafique Zuberi	Pakistani	Business	Flat 1-B-6, Sea Gluf Appartment, Block-2, Clifton, Karachi	01 (One)	

Dated this 29th day of November, 2016.

Total **03 (Three)**

Witness to the above signature

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



THE COMPANIES ORDINANCE, 2016
(Public Company Limited by Shares)
ARTICLES OF ASSOCIATION

OF
DIGRI-GEN LIMITED
PRELIMINARY

1. The Regulations contained in Table 'A' to the First Schedule to the Companies Ordinance, 2016 (the "Ordinance") shall be the regulations of **DIGRI-GEN LIMITED** (the "Company") so far as these are applicable to a public company.

INTERPRETATION

2. Unless the context otherwise requires, words or expressions contained in these regulations shall have the same meaning as in the Ordinance; and words importing the singular shall include the plural and vice versa, and words importing the masculine gender shall include feminine, and words importing persons shall include bodies corporate.

(a) "section" means section of the Ordinance

(b) "the Ordinance" means the Companies Ordinance, 2016; and

(c) "The Company" means **DIGRI-GEN LIMITED**

(d) "the seal" means the common seal or official seal of the company.

(e) "Commission" means Securities and Exchange Commission of Pakistan (SECP).

(f) "Board" means the Board of Directors for the time being

(g) "Board Meeting" means a meeting of the Directors duly called and constituted or as the case may be the Directors assembled at a Board.

(h) "Member" means a person whose name is for the time being entered in the Register of Members by virtue of his being a subscriber to the Memorandum of Association of the Company or of his holding by allotment or otherwise any share, scrip or other security which gives him a voting right in the Company.

(i) "Special Resolution" shall have the meaning assigned thereto by the Ordinance. "The Office" means the Registered Office for the time being of the Company.

(j) "The Directors" shall mean the Directors for the time being and shall include alternate directors.

BUSSINESS

3. The directors shall have regard to the restrictions on the commencement of business imposed by section 19 if, and so far as, those restrictions are binding upon the company.

SHARES

4. In case of shares in the physical form every person whose name is entered as a member in the register to member shall, without payment, be entitled to receive, within thirty days after allotment or within fifteen days of the application for registration of transfer, a certificate under the seal specifying the shares held by him and the amount paid up thereon

   Provided that if the shares are in book entry form or in case of conveying of physical share and other transferable securities into book entry form, the company shall, within ten days after an application is made for the registration of the transfer of any shares or other security to a central depository, register such transfer in the name of central depository

5. The company shall not be bound to issue more than one certificate in respect of a share or shares in the physical form, held jointly by several persons and delivery of a certificate for a share to one of several joint holders shall be sufficient delivery to all.

6. If the share certificate in physical form is defaced, lost or destroyed , it may be renewed on payment of such fee, if any, not exceeding one hundred rupees, and on such terms, if any, as to evidence and indemnity and payment of expenses incurred by the company in investigating the title as the directors think fit.
7. Except to the extent and in the manner allowed by the section 86, no part of the funds of the company shall be employed in the purchase of, or in loans upon the security of, the company's shares.
8. The authorised capital of the company is Rs. 50,000,000/- (Rupees Fifty million only) divided into 5,000,000 (Five million) ordinary shares of Rs. 10/- (Rupees Ten only) each with powers to increase and reduce the capital of the company and to divide the shares in the capital for the time being into several classes in accordance with the provisions of the Companies Ordinance, 2016.

TRANSFER AND TRANSMISSION OF SHARES

9. The instrument of transfer of any share in physical form in the company shall be executed both by the transferor and transferee, and the transferor shall be deemed to remain holder of the share until the name of the transferee is entered in the register of members in respect thereof.
10. Shares in physical form in the company shall be trans in the following form , or in any usual or common form which the directors shall approve:-

FORM AND TRANSMISSION OF SHARES

(1st schedule to the Companies Ordinance, 2016)

I..... S/o .....F/o..... .....(hereinafter called "the transferor") in consideration of the sum of rupees .....paid to me by.....

I..... .....S/o.....F/o.....(hereinafter called "the transferee"), do hereby transfer to said transferee ..... the share (or share) with distinctive numbers from ..... to ..... inclusive, in the **DIGRI-GEN LIMITED** to hold unto the said transferee his executors, administrator and assigns, subject to the several conditions on which I held the same at the time of the execution hereof, and I, the said transferee, do hereby agree to take the said share (or shares) subject to the condition aforesaid.

As witness our hands the .....day of .....20.....

Signature .....
Transferor
Full Name, Father's Husband's Name
CNIC number (in case of foreigner, Passport Number.)
Nationality
Occupation and Usual Residential

Address

Signature .....
Transferee
Full Name, Father's Husband's Name
CNIC number (in case of foreigner, Passport Number.)
Nationality
Occupation and Usual Residential
Address
Cell number
Landline number, if any
Email address

Witness 1:

Signature.....
Date .....
Name, CNIC Number and full address

Witness 2:

Signature.....
Date.....
Name, CNIC Number and full address

Name, CNIC Number and Full Name, CNIC Number and Full Address

Bank Account Details of Transferee for payment of Cash Dividend

(Mandatory in case of a listed company or optional for any other company)

It is requested that all my cash dividend amounts declare by the company, may be credited in to the following bank account:

Title of Bank Account	
Bank Account Number	
Bank's Name	
Branch Name and Address	

It is stated that the above mentioned information is correct and that I will intimate the changes in the above-mentioned information to the company and the concerned Share Registrar as these occur.

.....

Signature of the Transferee(s)

11.

(1) Subject to the restrictions contained in regulation 10 and 11, the directors shall not refuse any share unless the transfer deed is defective or invalid. The director may also suspend the registration of transfers during the ten days immediately preceding a general meeting or prior to the determination of entitlement or rights of the shareholders by giving seven days previous notice in the manner provided in the Ordinance. The director may, in case of shares in physical form, decline to recognise any instrument of transfer unless:-----

(a) A fee not exceeding fifty rupees as may be determined by the directors is paid to the company in respect thereof, and

(b) the duly stamped instrument of transfer is accompanied by the certificate of the shares to which it relates, and such other evidence as the director may reasonably require to show the right of the transferor to make the transfer.

(2) If the director refuse to register the transfer of share, they shall within fifteen days after the date on which transfer deed was lodged with the company sent to the transferee and the transferor notice of the refusal indicating the defect or invalidity to the transferee, who shall, after removal of such defect or invalidity be entitled to re-lodged the transfer deed with the company:

Provided that the company shall, where the transferee is a central depository the refusal shall be convey within five days from the date on which the instrument of transfer was lodged without it notify the defect or invalidation to the transferee who, shall, after the removal of such defect or invalidity to the transferee who shall, after the removal of such defect or invalidity, be entitled to re lodge the transfer deed with the company.

TRANSMISSION OF SHARES

12. The executor, administrators, heir, or nominees, as the case may be, of a deceased sole holder of a share shall be the only person recognize by the company to deal with the share in accordance with the law. In the case of a share registered in the names of two or more holders, the survivors or survivor, or the executor or administrators of the deceased survivors, shall be the only person recognised by the company to deal with the share in accordance with law.

13. The shares or other securities of a deceased member shall be transferred on application duly supported by succession certificate or by lawful award, as the case may be, in favor of the successors to the extent of their interests and their names shall be entered to the register of members.

14. A person may on acquiring interest in a company as a member, represented by shares, at any time after acquisition of such interest deposit with the company as member, represented by shares, at any time after acquisition of such interest deposit with the company a nomination conferring on a person, being the relatives of the member, namely, a spouse, father, mother, brother, sister and son or daughter, the right to protect the interest of the legal heirs in the shares of the deceased in the event of his death, as a trustee and to facilitate the transfer of shares to the legal heirs of the deceased subject to succession to be determined under the Islamic law of inheritance and in case of non-Muslims members, as per their respective law.

15. The person nominated under regulation 12 shall, after death of the member, deemed as a member of company till the shares are transferred to the legal heirs and if the deceased was a director of the company, not being a listed company, the nominee shall also act as director of the company to protect the interest of the legal heirs.

16. A person to be deemed as a member under regulation 11,12 and 13 to share by reason of the death or insolvency of the holder shall be entitled if he were the registered holder of the share and exercise any right conferred by membership in relation to meetings of the company.

ALTERATION OF CAPITAL

17. The company may, by special resolution:

(a) increase its authorised capital by such amount as it thinks expedient;
(b) consolidate and divide the whole or any part of its share capital into shares of larger amount than its existing shares;
(c) sub- divide its shares, or any of them, into shares of smaller amount than is fixed by the memorandum;
(d) cancel shares which, at the date of the passing of the resolution in that behalf, have not been taken or agreed to be taken by any person and diminish the amount of the share capital by amount of the share so cancelled.

18. Subject to the provisions of the Ordinance, all new shares shall at the first instance be offered to such persons as at the date of the offer entitled to issue in proportion, as nearly as the circumstances admits, to the amount to the existing shares to which they are entitled. The offer

shall be made by letter of offer specifying the number of shares offered, and limiting the time within which the offer, if not accepted, will deem to be declined, and after the expiration of the time, or on the receipt of an intimation for the person to whom the offer is made that he declines to accept the shares offered, the directors may dispose of the same in such manner as they think most beneficial to the company. The directors may likewise so dispose of any new shares which (by reason of the ratio which the new shares bear to shares held by persons entitled to an offer of new shares0 cannot, in the opinion of the directors, be conveniently offered under this regulation.

19. The new shares shall be subject to be the same provisions with reference to transfer, transmission and otherwise as the shares in the original share capital.

20. The company may, by special resolution

(a) consolidate and divide its share capital into shares of larger amount then its existing shares;

(b) sub- divide shares or any of them into shares of smaller amount than is fixed by the memorandum od association, subject, nevertheless, to the provisions of section 85;

(c) cancel any shares which, at the date of the passing of the resolution, have not been taken or agreed to be taken by any person.

21. The company may, by special resolution, reduce its share capital in any manner and with, and subject to confirmation by the court and any incident authorised and consent required, by law.

GENERAL MEETINGS

22. The statuary general meeting of the company shall be held within the period required by section 131.

23. A general meeting, to be called annual general meeting, shall be held, in accordance with the provision of section 132. Within sixteen months from the date of incorporation of the company and thereafter once at least in every year within a period of four months following the close of its financial year.

24. All general meeting of company other than statuary meeting or annual general meeting mentioned in section 131 and 132 respectively shall be called extra ordinary general meetings.

25. The director may, whenever they think fit, call an extra-ordinary general meeting, and extra-ordinary general meetings shall also be called on such requisition, or in default, may be called by such requisitioinists, as provided by section 133. If at any time there are not within Pakistan sufficient directors capable of acting to form a quorum, any director of the company may called an extra- ordinary meeting in the same manner as nearly as possible as that in which meeting may be called by the directors.

26. The company may provide video-link facility to its members for attending general meeting at places other than the town in which general meeting is taking place after considering the geographical dispersal of its members:

Provided that in case of listed companies of the members holding ten percent of the total paid up capital or such other percentage of the paid up capital as may be satisfied, are resident in any other city, the company shall provide the facility of video-link to such member to attending annual general meeting of the company, if so required by such members in writing to the company at least seven days before the date of the meeting.

NOTICE AND PROCEEDINGS OF ANNUAL GENERAL MEETINGS

27. Twenty-one days' notice at the least (exclusive of the day on which the notice is served or deemed to be served, but inclusive of the day for which notice is given) specifying the place, the day and hour of meeting and, in case of special business, the general nature of that business, shall be given in manner to provided by the Ordinance for the general meeting, to such person as are, under the Ordinance or the regulations of the company, entitled to receive such notice from the company: but the accidental omission to give notice to, or the no-receipt of the notice by, any member shall not invalidate the proceedings at any general meeting.

28. All the business transacted at a general meeting shall be deemed special other than the business stated in sub-section (2) of section 134 namely: the consideration of financial statement and the reports of board and auditors, the declaration of any dividend, the election and appointment of directors in place of those retiring, and the appointment of the auditors and fixing of their remuneration.

29. No business shall be transacted at any general meeting unless a quorum of members is present at that time when the meeting proceeds to business. The quorum of the general meeting shall be---

(d) In the case of public listed company, not less than ten members present personally or through video-link who represent not less than twenty-five percent of the total voting power, either of their own account or as proxies;

(e) In case of any other company having share capital, two members present personally, or through video-link who represent not less than twenty-five percent of the total voting power, either of their own account or as proxies.

30. If within half hour from the time appointed for the meeting a quorum is not present, the meeting is called upon the requisition of members, shall be dissolved; in any other case, it shall adjourned to the same day in the next week at the same time, and place, and if at any adjourned meeting a quorum is not present within half an hour from the time appointed for the meeting, the members present, being not less than two, shall be a quorum.

31. The chairman of the board of directors, if any, shall preside as chairman at ever general meeting of the company , but if there is no such chairman, or if at any meeting he is not present within

fifteen minutes after the time appointed for the meeting, or is unwilling to act as chairman, any one of director present may be elected to be chairman, and if none of directors id present, or willing to act as chairman, the members present shall choose one of their number to be chairmen.

32. The chairman may with the consent of any meeting which the quorum is present (and shall if so directed by the meeting), adjourn the meeting from time to time but no business shall be transacted at any adjourned meeting other than the business left un'finished at the meeting from which the adjournment took place. When a meeting is adjourned for fifteen days or more than, notice of the adjourned meeting shall be given as in the case of an original adjournment or of the business to be transected at an adjourned meeting.

33. (1) at any time general meeting a resolution put to vote of the meeting shall be decided on a show of hands unless a poll is (before or on the declaration of the result of the show of hands) demanded. Unless a poll is so demanded, a declaration by the chairman that a resolution has, on a show of hands, been carried, or carried unanimously, or by a particular majority, or lost, and an entry to that effect in the book of the proceedings of the company shall be conclusive evidence of the fact, without proof of the number and proportion of the votes recorded in favor of, in against, the resolution.

(2) At any general meeting the company shall transact such businesses as may be notified by the commission, only through a postal ballot

34. A pool may be demanded only in accordance with the provision of section 143

35. If a poll is duly demanded, it shall be taken in accordance with the manner laid down in sections 144 and 145 and the result of the poll shall be deemed to be the resolution of the meeting at which the poll was demanded.

36. A poll demanded on the election of chairman or on a question of adjournment shall be taken at once.

37. In the case of any equality of votes, whether on a show of hands or on a poll, The chairman of the meeting at which the show of hands takes place, or at which the poll is demanded, shall have exercise a second or casting vote.

38. Except for the businesses specified under sub-section (2) of section 134 to be conducted in the annual general meeting, the member of a private company or a public listed company (having not more than fifty members), may pass a resolution (ordinary or special) by circular signed by all members for the time being entitled to receive notice of a meeting. The resolution by circulation shall be deemed to be passed on the date of signing by the last of signatory member to such resolution.

VOTES OF MEMBERS

39. Subject to any rights or restrictions for the time being attached to any case or classes of shares, on a show of hands every member present in person shall have one vote except for election of directors in which case the provision of section 159 shall apply. On a poll every member shall have voting rights as laid down in section 134.

40. In case of Join -holders, the vote of the senior who tenders a vote, whether in person or by proxy or through vid:o-link shall be accepted to the exclusion of votes of the other Joint holders; and for this purpose seniority shall be determined by the order in which the names stands in the register of members.

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

42. On a poll votes may be given either personally or through video link, by proxy or through postal ballot:

    Provided that nobody corporate shall vote by proxy as long as a resolution of its directors in accordance with the provisions of section 138 is in forced.

43.

    (1) The instrument appointing a proxy shall be in writing under the hands of the appointer or of his attorney duly authorised in writing.

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

44. An instrument appointing a proxy may be in the following form, or a form as near thereto as may be:

INSTRUMENT OF PROXY

Digri-Gen Limited

"I ..... s/o ..... r/o..... being a member of the Digri-Gen, Limited, hereby appoint ..... s/o ..... r/o ..... as my proxy to attend and vote on my behalf at the (statutory, annual, extraordinary, as the case may be) general meeting of the company to be held on the ..... Day of ....., 20.. ..and at any adjournment thereof".

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

DIRECTORS

46. The following subscribers of the memorandum of association, shall be first directors of the company, so however, that the number of directors shall not in any case be less than that specified in section 154 and they shall hold office until the election of directors in the first annual general meeting:

    I. Ahaidh Hassan Mohammad Javeri
    II. Mira Hilla Ayesha Javeri
    III. Muhammad Ali Jamal

47. The remuneration of the directors shall from time to time be determined by the company in general meeting subject to the provisions of the Ordinance.
48. Save as provided in section 153, no person shall be appointed as a director unless he is a member of the company.

POWERS AND DUTIES OF DIRECTORS

49. The business of the company shall be managed by the directors, who may pay all expenses incurred in promoting and registering the company, and may exercise all such powers of the company as are not by the Ordinance or any statutory modification thereof for the time being in force, or by these regulations, required to be exercised by the company in general meeting, subject nevertheless to the provisions of the Ordinance or to any of these regulations, and such regulations being not inconsistent with the aforesaid provisions, as may be prescribed by the company in general meeting shall invalidate any prior act of the directors which would have been valid if that regulation had not been made.

50. The directors shall appoint a chief executive in accordance with the provisions of sections 186 and 187.
51. The amount for the time being remaining undischarged of moneys borrowed or raised by the directors for the purposes of the company (otherwise than by the issue of share capital) shall not at any time , without the sanction of the company in general meeting, exceed the issued share capital of the company.
52. The directors shall duly comply with the provisions of the Ordinance or any statutory modification thereof for the time being in force, and in particular with the provisions in regard to the registration of the particulars of the mortgages, charges and pledge affecting the property of

the company or created by it, to the keeping of a register of the directors, and to the sending to the registrar of an annual list of members, and a summary of particulars relating thereto and notice of any consolidation or increase of share capital, or sub-division of shares, and copies of special resolutions and a copy of the register of directors ad notifications of any changes therein.

MINUTE BOOKS

53. The directors shall cause records to be kept and minutes to be made in book or books with regard to---

(a) All resolutions and proceedings of general meeting(s) and the meeting(s) of directors and Committee(s) of directors, and every member present at any general meeting and every director present at any meeting of the directors or Committee of directors shall put his signature in a book to be kept for the purpose:

(b) Recording the names of the persons present at each meeting of the directors and of any committee of the directors, and the general meeting; and

(c) All orders made by the directors and Committee(s) of directors:

Provided that all records related to proceedings through video-link shall be maintained in accordance with the relevant regulations specified by the Commission which shall be appropriately rendered into writing as part of the minute books according to the said regulations.

THE SEAL

54. The directors shall provide for the safe custody of the seal and the seal shall not be affixed to any instrument except by the authority of a resolution of the board of directors or by a committee of directors authorized in that behalf by the directors and in the presence of at least two directors and of the secretary of such other person as the directors may appoint for the purpose; and those two directors and secretary or other person as aforesaid shall sign every instrument to which the seal of the company is so affixed in their presence.

DISQUALIFICATION OF DIRECTORS

55. No person shall become the director of a company if he suffers from any of the disabilities or disqualifications mentioned in section 153 or disqualified or debarred from holding such office under any of the provisions of the Ordinance as the case may be and, if already a director, shall cease to hold such office from the date he so becomes disqualified or disabled:

Provided, however, that no director shall vacate his office by reason only of his being a member of any company which has entered into contracts with, or done any work for, the company of

which he is director, but such director shall not vote in respect of any such contract or work, and if he does so vote, his vote shall not be counted.

PROCEEDINGS OF DIRECTORS

56. The directors may meet together for the dispatch of business, adjourn and otherwise regulate their meetings, as they think fit. A director may, and the secretary on the requisition of director shall, at any time, summon a meeting of directors. Notice sent to a director through email whether such director is in Pakistan or outside Pakistan shall be a valid notice.

57. The directors may elect a chairman of their meetings and determine the period for which he is to hold office; but, if no such chairman is elected, or if at any meeting he chairman is not present within ten minutes after the time appointed for holding the same or is unwilling to act as chairman, the directors present may choose one of their number to be chairman of the meeting.

58. At least one-third (1/3rd) of the total number of directors or two (2) directors whichever is higher, for the time being of the company, present personally or through video link, shall constitute a quorum.

59. Save as otherwise expressly provided in the Ordinance, every question of meetings of the board shall be determined by a majority of votes of the directors present in person or through video-link, each director having vote. In case of an equality of votes or tie, the chairman shall have a casting vote in addition to his original vote as a director.

60. The directors may delegate any of their powers not required to be exercised in their meeting to committees consisting of such member or members of their body as they think fit; any committee so formed shall, in the exercise of the powers so delegated, conform to any restrictions that may be imposed on them by the directors.

61. (1) A committee may elect a chairman of its meetings, but if no such chairman is elected, or if at any meeting the chairman is not present within ten minutes after the time appointed for holding the same or is unwilling to act as chairman, the members present may choose one of their number to be chairman of the meeting.

(2) a committee may meet and adjourn as it thinks proper. Questions arising at any meeting shall be determined by a majority of votes of the members present. In case of an equality of votes, the chairman shall have and exercise a second or casting vote.

62. All acts done by any meeting of the directors or of a committee of directors, or by any person acting as a director, shall, notwithstanding that it be afterwards discovered that there was some defect in the appointment of any such directors or persons acting as aforesaid, or that they or any of them were disqualified, be as valid as if every such person had been duly appointed and was qualified to be a director.

63. A copy of the draft minutes of meeting of the board of directors shall be furnished to every director within seven working days of the date of meeting.

64. A resolution in writing signed by all the directors for the time being entitled to receive notice of a meeting of the directors shall be as valid and effectual as if it had been passed at a meeting of the directors duly convened and held.

FILLING OF VACANCIES

65. At the first annual general meeting of the company, all the directors shall stand retired from office, and directors shall be elected in their place in accordance with section 159 for a term of three years.
66. A retiring director shall be eligible for re-election.

67. The directors shall comply with the provisions of sections 154 to 159 and sections 161, 162 and 167 relating to the election of directors and matters ancillary thereto.

68. Any casual vacancy occurring on the board of directors may be filled up by the directors, but the person so chosen shall be subject to retirement at the same time as if he had become a director on the day on which the director in whose place he is chosen was last elected as director.
69. The company may remove a director but only in accordance with the provisions of the Ordinance.

DIVIDEND AND RESERVE

70. The company in general meeting may declare dividends but no dividend shall exceed the amount recommended by the directors.

71. The directors may from time to time pay to the members such interim dividends as appear to the directors to be justified by the profits of the company.

80. 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 and shall be open to inspection by the directors during business hours.

81. The directors shall from time to time determine whether and to what extent and t what time and places and under what conditions or regulations the accounts and books or papers of the company or any of them shall be open to the inspection of members not being directors, and no member (not being a director) shall have any right of inspecting any account and book or papers of the company except as conferred by law or authorized by the directors or by the company in general meeting.

82. The directors shall as required by section223 and 226 cause to be prepared and to be laid before the company in general meeting the financial statements duly audited and reports as are referred to in those sections.

83. The financial statements and other reports referred to in regulation 80 shall be made out in every year and laid before the company in the annual general meeting in accordance with sections 132 and 223.

84. A copy of the financial statements and reports of directors and auditors shall, at least twenty-one days preceding the meeting, but sent to the persons entitled to receive notices of general meetings in the manner in which notices are to given hereunder.

85. The directors shall in all respect comply with the provisions of sections 220 to 227.

86. Auditors shall be appointed and their duties regulated in accordance with sections 246 to 249.

NOTICES

87. (1) A notice may be given by the company to any member to his registered address or if he has no registered address in Pakistan to the address, if any, supplied by him to the company for the giving of notices to him against an acknowledgement or by post or courier service or through electronic means or in any other manner as may be specified by the Commission.

(2) Where a notice is sent by post, service of the notice shall be deemed to be effected by properly addressing, prepaying and posting a letter containing the notice and, unless the contrary is proved, to have been effected at the time at which the letter will be delivered in the ordinary course of post.

88. A notice may be given by the company to the joint-holders of a share by giving the notice to the joint-holder named first in the register in respect of the share.

89. A notice may be given by the company to the person entitled to a share in consequence of the death or insolvency of a member in the manner provided under regulation 85 addressed to them

by name, or by the title or representatives of the deceased, or assignees of the insolvent, or by any like description, at the address, supplied for the purpose by the person claiming to be so entitled.

90. Notice of every general meeting shall be given in the manner hereinafter authorized to (a) every member of the company and also to (b) every person entitled to a share in consequence of the death or insolvency of a member, who but for his death or insolvency would be entitled to receive notice of the meeting, and (c) to the auditors of the company for the time being and every person who is entitled to receive notice of general meetings.

DISPUTE

91. In the event that a dispute, claim or controversy arises between the Company, its management of its shareholders, or between the shareholders inter-se, or the directors 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 to formal dispute resolution such as arbitration or litigation.

WINDING UP

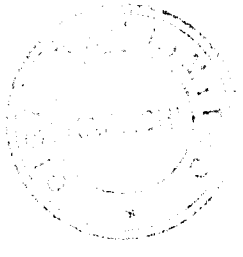
92. (1) In the case of members; voluntary winding up, with the sanction of a special resolution of the company, and , in the case of creditors' voluntary winding up, of a meeting of the creditors, the liquidator shall exercise any of the powers given by sub-section (1) of section 337 of the Ordinance to a liquidator in a winding up by the Court including inter-alia divide amongst the members, in specie or kind, the whole or any part of the assets of the company, whether they consist of the same kind or not.

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

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

INDEMNITY

93. Every office or agent for the time being of the company may be indemnified out of the assets of the company against any liability incurred by him in defending any proceedings, whether civil or criminal, arising out of his dealings in relation to the affairs of the company, except those brought by the company again him, in which judgment is given in his favour or in which he is acquitted, or in connection with any application under section 492 in which relief is granted to him by the Court.



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 set opposite our respective names :

Name and Surname (Present and former, in full and block letters)	CNIC No.	Father's / husband Name	Nationality with any former Nationality	Occupation	Residential address in full	Number of shares taken by each subscriber	Signature
Ahaidh Hassan Mohammad Javeri	42301-3898307-5	S/o. Naveed Mohammad Javeri	Pakistani	Business	House D-195, Block-5, Clifton, Karachi	01 (One)	
Mira Hilla Ayesha Javeri	42301-6067953-4	D/o. Naveed Mohammad Javeri	Pakistani	Business	House D-195, Block-5, Clifton, Karachi	01 (One)	
Muhammad Ali Jamal	42301-5689797-5	S/o. Jamal Rafique Zuberi	Pakistani	Business	Flat 1-B-6, Sea Gluf Appartment, Block-2, Clifton, Karachi	01 (One)	
				Total		**03 (Three)**	

Dated this 29th day of November, 2016.

Witness to the above signature

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

PROSPECTUS

PROSPECTUS

BRIEF INTRODUCTION OF THE APPLICANT

M/s Digri Sugar Mills Ltd (DSML), Taluka Digri, District Mirpur Khas, Sindh, is engaged in the manufacturing / sale of sugar and it operates as one of the prominent sugar mills in the country with crushing capacity of 7000 TCD (tons cane crushing capacity per day) and capacity to generate Appprox. 25 MW power by developing of Power Plant based on high pressure boilers technology.

M/s DSML has already been operating and maintaining a Bagasse based 06 MW Power Plant based upon 2 x 25 bar Boilers and 2 x 3 MW Steam Turbine Generators, to meet with its own steam and power requirements successfully. M/s DSML had also entered into Power Purchase Agreement with HESCO on 05.07.2012 for supply of 2.0 MW power under PEPCO's SPPs/CPPs Policy. However, the supply of power could not be started due to certain reasons including increase of steam and power requirement at the Sugar Mills.

Keeping in view its crushing capacity, the BoD of M/s DSML resolved to develop a new 25 MW Bagasse/Biomass based Co-Generation Power Project as a separate entity for power generation to meet with power requirements of DSML and sale of spillover power to national grid. Consequent thereupon, a new power company has been got incorporated under the name and style of "**Digri Gen Limited**" (DGL).

In line with its goal, M/s DGL has planned to develop a new Approx. Bagasse/Biomass based 25 MW Cogeneration Power Plant on high pressure technology boilers to meet with steam and power requirements of M/s DSML and sale of spillover power to national grid.

The proposed Approx. 25 MW Bagasse/Biomass based Cogeneration Power Project shall be developed by M/s DGL under and pursuant to the GoP's Policy for Development of Renewable Energy for Power Generation read with Framework for Power Co-generation 2013 (Bagasse/Biomass) and Upfront Tariff determined by NEPRA for new Bagasse based Co-generation Projects in May, 2013 (modified in July, 2015).

SALIENT FEATURES OF THE FACILITY FOR WHICH LICENSE IS SOUGHT

The Facility shall employ 25 MW Steam Turbo Generator (STG) for power generation. The generated power shall be dispatched to the National Grid at 132kV level by upgrading already existing 11kV DSML-HESCO's 132kV Digri Grid Station.

1	Plant location	Taluka Digri, District Mirpur Khas, Sidh, Pakistan
2	Plant Capacity	25 MW (Gross)
3	Technology	Conventional steam power cycle
4	Installed capacity	25,000 KW (Gross)
5	Plant details i. Steam Turbo generators ii. Boiler	1 x 25 MW Extraction/Condensing type Steam Turbine Generator 1 x 100 - 140 ton/hr, 115 bar, 540°c High Pressure Boiler

The company shall opt for the upfront tariff for New Bagasse Based Co-Generation projects determined by NEPRA in May 2013 under the Framework for Power Cogeneration 2013 for Bagasse/Biomass to include bagasse/biomass under the ambit of the Renewable Energy Policy, 2006.

PROPOSED INVESTMENT

The proposed investment is expected to be approximately US$ 3,125 Million and shall be made through 80% bank loan and 20% equity.

SOCIAL AND ENVIRONMENTAL IMPACT OF THE PROPOSED FACILITY

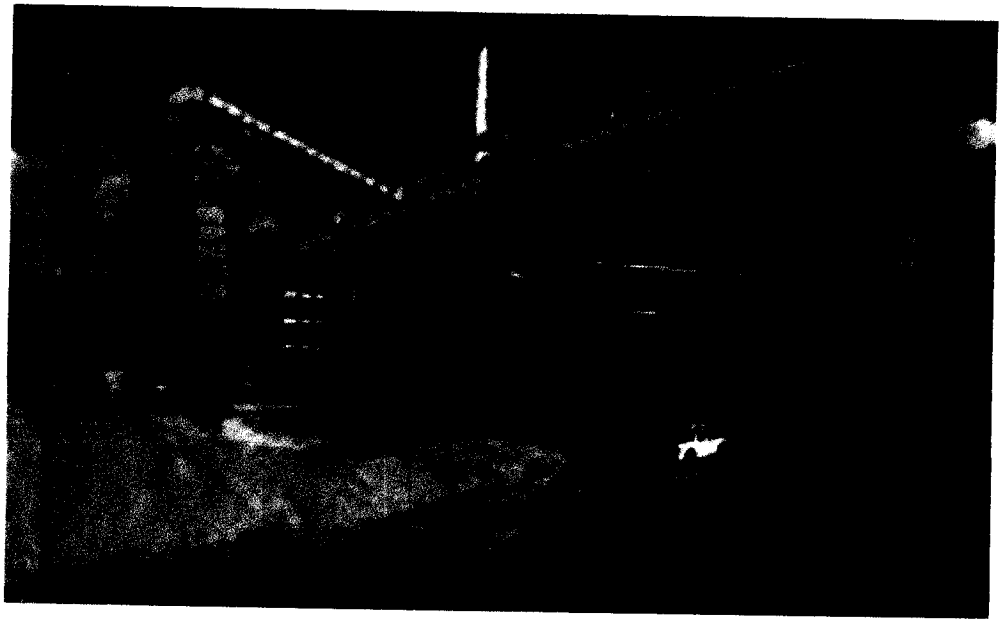
Bagasse is a by-product produced during the sugar manufacturing process and is an environmental friendly biomass fuel and helps reduce emission of Green House Gasses. Governments across the Globe including Pakistan and neighboring India have incentivized biomass based generation to reduce the effects of Global Warming and to promote the use of indigenous energy sources for electricity generation.

Bagasse based generation like DGL, provide the following benefits:

- Import substitution by replacing costly furnace oil, saving precious foreign exchange. It is estimated that approximately 3,000 MW can be generated by sugar mills located in various parts of the country.
- Contributing towards reducing the electricity shortfall during the low generation months as sugar mills operate in the winter months i.e. non-gas and non-hydel months
- Since Bagasse based generation offers direct replacement for furnace oil/diesel based generation it offers a clear price advantage.
- Environment friendly nature of the fuel helps in reducing Green House Gases and Carbon Footprints.
- The Project will use a high pressure boiler to generate electricity for sale to the national grid. The higher steam parameters shall result in more energy dispatch from the same fuel.
- Reducing distribution costs. Sugar Mills are located in rural areas and are vastly spread and, therefore, are ideal vehicles for cheap distribution of power to rural areas and non-traditional load centers.

FEASIBILITY STUDY REPORT

25 MW Cogeneration Power Project by Digri Sugar Mills Limited Located at Taluka Digri, District Mirpur Khas, Sindh



March, 2017

ALTAF HUSSAIN
Project Manager
Digri-Gen Limited

Executive Summary

1.0 Introduction

1.1 Bagasse is the fibrous matter that remains after sugarcane or sorghum stalks are crushed to extract their juice and is a by-product generated in the process of manufacture of sugar. It can either be sold or be captively consumed for generation of steam. It is currently used as a bio-fuel and in the manufacture of pulp and paper products and building materials. The bagasse produced in a sugar factory is however used for generation of steam which in turn is used as a fuel source and the surplus generation is exported to the power grids of state governments.

1.2 For each 10 tonnes of sugarcane crushed, a sugar factory produces nearly 3 tonnes of wet bagasse. Since bagasse is a by-product of the cane sugar industry, the quantity of production in a country is in line with the quantity of sugarcane produced.

1.3 Bagasse based Cogeneration, for additional power generation in sugar industry, offers a number of advantages both to the sugar company and to the country. Apart from helping in bridging the gap between the demand and the supply in the power sector, the bagasse based Cogeneration offers an environmentally friendly solution for additional power generation, helps in reducing the dependence on the fossil fuels, saves on the foreign currency outflow from the country and improves the financial position of the sugar factory. Bagasse based Cogeneration is being extensively used in India where the installed generation capacity is close to 1800 MW with more plants under implementation. The other countries that had exploited bagasse based Cogeneration to a major extent are Mauritius (around 250 MW), Reunion Island (around 220 MW), Brazil etc.

2.0 Background

2.1 Digri Sugar mills (DSML) operates its sugar mill in Mirpur Khas district of the Sindh Province in Pakistan. This sugar mill has a capacity of 7000 Tonnes of Cane per day with utilization factor 90%, 262.5 (TCH), and crushing period of about 120 days in a year.

2.2 DSML's sugar mill is modern and they have installed the most modern plant & machinery in the sugar mill. DSML, with an excellent management team and the best machinery ensure good performance of the sugar mill and consequently the mill is among the top sugar mills in the Sindh Province in terms of sugarcane crushing, production, recovery and efficiency. DSML is located in an excellent cane growing area of the Sindh Province. Located at Taluka Digri, District Mirpur Khas, Sindh. The mill has good access by road. The factory is about 10kms from the town of Digri. The nearest airport is at Hyderabad and the nearest seaport is Karachi at a distance of about 300 km. The factory is well connected by road to Hyderabad and Karachi through highway.

2.3 Considering the good cane potential in the command area of the sugar mill, DSML is planning to enhance the crushing capacity of the sugar mill from 7000 TCD to 8000 TCD.

3.0 Project Rationale & Drivers

3.1 While expanding the crushing capacity of the sugar mill, DSML is planning for the implementation of the high pressure Cogeneration program to generate grid quality exportable power. Eventhough the sugar mill operation with the existing steam and power generation system is quite comfortable, DSML is contemplating high pressure Cogeneration due to the following reasons:

- Contributing to the growth of the country's economy by generating the much-needed electricity.

- Helping to reduce the foreign exchange outflow by using a local renewable fuel, instead of the costly imported fossil fuel for generating electricity.

- Putting an energy resource like bagasse to better use and maximizing the power generation with bagasse. The bagasse, which is a renewable energy source, contributes to the reduction in the green house gases.

- Improving the Energy efficiency of the plant, as inefficiency in any form is to be eliminated in this energy deficient world.

3.2 With the stabilization of the crushing at 7000 TCD, the potential for additional power generation at DSML is very good. With Cogeneration in mind, the company had taken adequate care in ensuring the sustainability of the crushing. To that effect DSML has been concentrating on cane development to get assured cane for crushing. Also DSML, with the view to enhancing the power export potential, is planning for conversion of the steam turbine drives of the mills and the cane preparatory devices to electric drives. They had already made adequate efforts in reducing the steam consumption and going in for the energy efficiency measure in the process area to reduce the thermal energy consumption. With these forward planning, the implementation of Cogeneration could become much easier in this sugar mill. With the implementation of the energy efficiency measures, there will be a remarkable reduction in the process steam and power consumption in the sugar mill, enhancing the energy export to the grid.

3.3 Currently Pakistan has an installed electric generating capacity of about 20,000 MW, with the demand far exceeding this installed capacity and the access to electricity in Pakistan is about 62%. With a fast-growing economy and demography, the projection for the demand in 2030 is forecast to be 100,000 MW. This calls for a tremendous growth rate in the power sector. The Government of Pakistan is making all out efforts to increase the generation capacity by tapping all conventional and non-conventional sources of electricity generation. Born out of this Government's initiative to augment the generation through non-conventional energy sources is the "National Policy for Power Cogeneration by Sugar Industry" promulgated in January 2008. The Government of Pakistan has recognized that Bagasse based Cogeneration can play a significant role in the country's efforts to augment the electricity generation.

3.4 The Government's pro-active policy on power Cogeneration created a lot of interest in the sugar Industry in Pakistan. The sugar Industry, suffering due to the vagaries of nature and global market fluctuations had been looking for support from the Government on the cogeneration initiative. However after the initial euphoria, the policy aimed at laying down clear guidelines about tapping the bagasse based Cogeneration potential, did not evoke much of interest. The major probable reasons, why there was not much of enthusiasm, were the minimum size of 60 MW and the treatment of the Cogeneration plants as IPPs. With no sugar mill coming forward to implement the Cogeneration program, the sugar industry has taken up the matter with the Government and the new initiative by the industry and the Government has brought about a new policy framework in 2013 which promises great hopes for bagasse based Cogeneration in Pakistan. Under this new policy framework, five (5) power plants have already achieved successful commercial operation and contributing electricity to the national grid.

4.0 Project Sponsors

4.1 For the implementation of the Cogeneration program, DSML has set up a new company called the "Digri-Gen Limited" (DGL). DGL will be undertaking the power project development, construction and operation activities. DGL will sell power and steam to DSML for latter's operation and get bagasse in return from DSML. DGL will sign the Energy Purchase Agreement with the Central Power Purchase Agency (Guarantee) Limited (CPPA) - the Power Purchaser and sell the surplus power to the Power Purchaser. In the new company DSML will be a major stakeholder.

4.2 The bagasse generation in the sugar mill is reasonably good, at 30% on cane, on account of the high fibre in cane, and the generated bagasse is not fully utilized presently. Even with the present crushing of 7000 TCD, DSML saves and hence sells a lot of bagasse. The high crushing capacity and the high percentage of bagasse make this sugar mill an ideal candidate for the implementation of the Cogeneration program. Fully aware of the benefits of Cogeneration to the company as well as to the power starved country, DSML has proposed the Cogeneration project and DGL will take up the implementation of the Cogeneration project in sugar mill.

4.3 Under the present arrangement, the sugar plant's complete steam and power requirements are being met by low pressure boilers with matching 2 turbines of 3MW each. In addition, there are quite a few steam turbine drives to drive the mills and the cane preparatory system devices, which are inherently inefficient. Under the Cogeneration program, the low-pressure boiler and the existing turbogenerators will be retired in phases. The drive turbines will be replaced by electric motors. The entire quantity of the steam and power requirements of the sugar plant will be met by the new Cogeneration plant.

4.4 DSML being progressive has already initiated measures to make the sugar mill energy efficient and consequently the steam consumption in the process is 42% on cane. For a sugar mill producing refined sugar this is an appreciable achievement. The sugar mill is running comfortably as the total installed capacity for steam generation is adequate for meeting this requirement. Using the steam generated, the mill is generating enough electricity to meet with all the internal requirements. This existing facility will meet with the requirements of the mill even with the enhanced crushing at 8000 TCD. DSML had embarked on the energy conservation measures, to bring down the steam consumption to 42%, while the contemporary mills are consuming around 55. When the Cogeneration plant is installed and operating, the process steam consumption of the sugar plant will be 42% and only this quantity of steam is considered to be extracted from the Cogeneration plant.

4.5 With the establishment of the proposed Cogeneration project, DSML will enter into agreement with DGL, the operator of the Cogeneration plant, for selling bagasse and buying power and steam.

5.0 Technology

5.1 For the proposed Cogeneration program DGL is interested in going in for the proven latest technology. With the gasification of bagasse has still not attained full-scale commercial exploitation; the only technology available for using the bagasse is through the combustion route. The technology chosen is the conventional thermal power plant technology based on the Rankine Cycle. The bagasse will be combusted in a high-pressure boiler and the steam generated will be fed to the steam turbine to generate power. The turbine will be different from the conventional thermal power plants, as the turbine will be provided with a controlled extraction for extracting the process steam required for the sugar mill. To enhance the efficiency of operation, regenerative heaters are used in the feed water circuit. For the Cogeneration power plant proposed for DGL, the Cogeneration cycle is based on the parameters of 115 bar(a) and 540 °C at the boiler outlet, currently being used in many countries for the Cogeneration projects. The cycle chosen with the above parameters is the latest used in any of the bagasse-fired installations around the world. These above selected parameters make the cycle more efficient and help in the generation of more units for the same quantum of the fuel. There are already a few Cogeneration plants operating in India with these parameters and the operating experience of those plants, in synchronization with the sugar mill operation, has been smooth and without any hitch. DSML is planning to establish 1x100 TPH capacity boiler with 1x25 MW turbogenerator. Considering the off-season operation of the plant, the Cogeneration power plant boilers will be designed for firing the saved bagasse and a few other compatible biomass fuels.

5.2 Considering 120 days of crushing operation and an overall capacity utilization of 90%, the sugar plant will generate around 219,240 MT of Bagasse which shall be used for running the Cogeneration plant during the crushing period. The number of operation days in the off-season could be enhanced if bagasse from other sugar mills is purchased and also suitable compatible biomass fuel is identified. Even if the biomass fuel is available during the seasonal operation, it could be used along with bagasse and more quantum of bagasse could be saved for more number of days of operation in the off-season.

5.3 The power requirement of the sugar mill during the season operation, excluding the power requirements of the Cogeneration power plant is expected to be 7.5 MW. During the off-season period, the power requirement is estimated to 3.5 MW, mainly for meeting the power required for the off-season maintenance of the sugar plant machinery and for meeting the colony and office power requirements.

5.4 Considering the above, the exportable power to the national Grid comes to 17.5 MW during season and 21.5 MW during off-season.

5.5 Considering the huge investment and also the round the year power requirement of the grid, DGL will operate the Cogeneration power plant in power plant mode both during season and off-season. The season operation of the Cogeneration plant consumes a lot of bagasse, but still leaves some surplus quantity for the off-season operation of the power plant. The plant will operate with the saved bagasse for a period of approximate ±60 days. DGL wants to operate the plant for approximately 300 days in a year for which bagasse would be purchased from other sugar mills and compatible bio-mass fuel like rice husk, wood chips etc. shall also be arranged.

5.6 The plant and equipment for the new proposed Cogeneration system will consist of the high pressure boiler, extraction condensing turbogenerator, water cooled condensing system, main and auxiliary cooling water system, water treatment plant system, condensate and feed water system, compressed air system and electrical system consisting of switchgears, LT distribution panels, Variable Frequency Drives, step up transformer to export the power, step down transformers for meeting the in-house power requirement, outdoor switchyard equipment etc.

5.7 The water requirement of the Cogeneration plant is proposed to be met mostly by the ground water through deep bore wells. The ground water aquifers get charged within boundary. The present raw water requirement of the sugar mill is being met by the drawl from these sources. The water from the bore wells will be stored in a new water reservoir, and drawn for usage in the Cogeneration plant. A water treatment plant based on the reverse osmosis principle is proposed for the treatment of the entire feed water for the Cogeneration plant. There will be an adequately designed pre-treatment system with Multigrade filter and Ultra filtration system upstream of the RO plant.

6.0 Efficiency & Heat Rates

6.1 Under the season operation, the boiler working with bagasse as the fuel will operate with a thermal efficiency of 70% based on the HHV of the fuel. With the bagasse HHV and the LCV respectively at 9311.44 kJ/kg and 7457.09 kJ/kg, the boiler efficiency with the LCV works out to 87.6%. With the net usable electrical power output, the Cogeneration plant, the plant electric efficiency based on the fuel LCV comes to 21.64%. The plant heat rate works out to 16,628.26 kJ/kwh. However considering the useful thermal energy output from the Cogeneration plant, the Combined Heat and Power (CHP) efficiency of the Cogeneration plant comes to 76.65%.

6.2 During the off-season operation, the plant operates in a power generation mode, without any process steam supply to the sugar mill. Using the bagasse, the net electric efficiency based on the LCV of the bagasse works out to 29.25%. The corresponding plant heat rate works out to 12,303.35 kJ/kwh.

7.0 Generation & Grid Interconnection

7.1 The bulk of the power generated in the proposed Cogeneration plant is meant for export to the grid. The power generation in the new Cogeneration TG will be at 11 kV level. The power plant's internal consumption requirement will be met by stepping down the voltage level to 0.4KV. Similarly the sugar mill's requirement will be met by stepping down the voltage from 11 KV to 0.4KV. However considering the stability and the uninterrupted export of power, the exportable power will be stepped up to 132 kV and paralleled with the national grid at 132 kV level. In the case of DGL's Cogeneration plant, the paralleling with the grid will be done at the SEPCO's grid Sub-station at Digri.

8.0 Implementation Schedule

8.1 The implementation of the proposed new Cogeneration system first phase is expected to be completed within Twenty (20) months, from the date of release of advance payment to the Supply Contractors. The Commercial Operation Date (COD) of the cogeneration project is expected to be in March 2019.

8.2 The size of the project calls for proper project management and control procedures to ensure implementation within the scheduled program. Adequate qualified and trained manpower shall be recruited to take care of the implementation of the new Cogeneration system. DGL plans for engaging an Operation and Maintenance team to take over the O&M of the plant.

8.3 The project shall be executed through the package route with an EPCM consultants carrying out the Engineering, Procurement and Construction Management activities. The EPCM consultant shall make the basic design of the plant, divide the project into logical and manageable packages, prepare the procurement specifications and assists DGL in the procurement of the packages. Once the packages are ordered, the EPCM consultant shall expedite with the contractors, reviews drawings, co-ordinate all the activities between the contractors and manage the implementation of the project. The complete Cogeneration plant civil works will be executed by a separate contractor. Based on the overall project guarantees, individual package guarantees are arrived at and specified in the contracts of the individual packages.

9.0 Project Cost Estimate

The Project Cost for the implementation of the 1x25 MW cogeneration plant at DGL will be US$ 31.25 Million.

10.0 Conclusion

Bagasse based Cogeneration is being considered by many countries as an environment friendly way of augmenting the generation capacity. The Government of Pakistan has estimated a potential of 3000 MW of Cogeneration power from the existing sugar mills, and has decided to fast track these projects. DSML's sugar mill with 7000 TCD of crushing per day will be able to sustain the generation of 25 MW of power in DGL's Cogeneration plant in first phase for a period of about 180 days, with the bagasse generated in the mill. The proposed Cogeneration plant of DGL, when implemented, will export a substantial quantum of power to the national grid. The proposed Cogeneration cycle is already proven and implementation of this project will benefit both the sugar mill and the country.

1.0 Cogeneration Plant Technology and Scheme Proposed for the Project

1.1 Cogeneration Plant Proposed for DGL

The Cogeneration plant proposed of DGL will be based on the boiler outlet steam parameters of 115 bar (a) and 540 °C. The steam parameters at the inlet of the turbine will be 105 bar(a) and 535 °C. The plant will be capable of meeting all the process steam and power requirements of DSML's sugar mill's expanded capacity at 7000 TCD crushing. Operating in parallel with the sugar mill and synchronizing with the national electricity grid and using the bagasse generated in the sugar mill during the season operation, the Cogeneration plant will export power to the sugar mill and to the grid. During the off-season the sugar mill does not operate but the Cogeneration power plant will operate, in full power generation mode, on the saved and / or purchased bagasse and / or on biomass fuel to export bulk of the power generated to the grid.

1.1.1 The nominal cane crushing capacity of the sugar plant, for designing the Cogeneration plant, will be 7000 TCD in 24 hours or 262.5 Tonnes of Cane per Hour (TCH). The plant will continue to be with the milling system for juice extraction.

1.1.2 The nominal crushing period for the DSML's sugar plant will continue to be 120 days in a year. The plant crushes continuously for the above period and then the plant is taken for the off-crop maintenance. During the crushing period the plant will operate continuously but for occasional shutdowns for plant cleaning and maintenance and for reasons of non-availability of cane for short durations.

1.1.3 DSML has done a lot of improvements in the operation of the sugar mill and consequently the sugar mill had been undergoing a lot changes. Depending on the cane availability and many other factors, there could have been a lot of ups and downs in the crushing and the actual factory time efficiencies recorded earlier will not be relevant. Considering the efforts being made by DSML and cane development programs being initiated by them it is expected that the overall plant capacity utilization will not be less than 90% of 7000 TCD at the time of the Cogeneration programs implementation.

1.1.4 The average bagasse percentage on cane is 30% and a provision of 1.0% is made for meeting with the requirements of bagasse for vacuum filtration and to account for losses. The balance of 29% (on cane) of bagasse will be available for the operation of the Cogeneration plant. With 262.5 TCH of crushing the bagasse generated in the plant will be 76 TPH. Out of this 2.6 TPH of bagasse (about 3.33% of the bagasse generated) is set aside for meeting with the above indicated bagacillo requirements, losses and the start up requirements of the boiler and the balance is taken to be available for using in the Cogeneration plant. This much quantum of bagasse will be available in DSML for sale to DGL.

1.1.5 The bulk of the process steam requirement of the sugar mill, at the consumption point, is at the pressure of 2.5 bar (a) and at saturated temperature at 127.43 °C. The requirement of this low-pressure steam shall be 41% of the cane crushed. In addition to the above the process also needs 1% of the cane crushed at 8 bar (a). The temperature of this 8 bar (a) steam will be 180 °C. On the whole the total process steam consumption comes to 42% on cane. Considering the fact that DSML manufactures white refined sugar, this steam consumption may be only slightly on the higher side. As DSML is

constantly modernizing and updating the technology, this steam consumption could also come down to 38 to 40% on cane.

1.1.6 With the view to enhancing the export from the Cogeneration plant, DSML/DGL will be replacing the inefficient steam turbine drives in the sugar mill with electric motors drives. The mills that crush the cane are presently driven by steam turbines and the same will be replaced with electric motors.

1.1.7 The sugar mill presently operates low pressure boilers with two 2x3 MW turbines. With the commissioning of DGL's Cogeneration plant, existing low pressure boiler and turbogenerator at DSML will be retired in phases.

1.1.8 The Cogeneration plant boilers will be designed with a travelling grate with hydraulic drive to burn bagasse, and biomass fuels. The outlet steam parameters will be 115 bar (a) and 540 °C. The boiler MCR capacity will be 100 TPH. The inlet feed water temperature will be 210 °C, with the feed water heated in two stage high pressure feed water heaters. The deaerator outlet water temperature will be around 130 °C, depending on the extraction pressure.

1.1.9 The proposed new turbogenerator will be of 25 MW nominal capacity. The turbine will be extraction condensing type machine.

1.1.10 The deaerator will be serving the dual purpose of deaerating the feed water as well as heating the feed water, to raise its temperature, with the extraction steam. The deaerator will be operating at around 2.7 bar (a) pressure, with the deaerated feed water temperature at around 130 °C. The deaerator will receive the condensate from the surface condenser, the condensate of the heating steam from the sugar process and the feed water make up. The condensate of the heating steam

from the feed water heaters will be cascaded to the deaerator, to optimally use the energy in the feed water heating steam.

1.1.11 Once the Cogeneration program is implemented, process steam requirement of the sugar mill will be partially catered by the steam drawn from the turbine extraction. Suitably sized pressure reducing and de-superheating stations will be provided for meeting the process steam requirement of DSML, in case of any problem in drawing the steam from the turbine extraction. The turbine extraction could get disabled when there is a grid failure and the turbine is forced to operate only for meeting the house loads.

1.1.12 The exportable power will be stepped up to 132 kV and will be connected to the nearby SEPCO's grid station at Digri through double circuit overhead transmission lines.

1.1.13 Presently there will be no distillery or any other chemical process plant with in the complex of the sugar mill, However, for the present, the extractions from the Cogeneration plant turbine will just meet with the requirements of the sugar mill process only.

1.1.14 The primary responsibility of the Cogeneration plant, during the season operation, is to provide the process steam and the required electrical energy to the sugar mill. The export of power to the grid comes after meeting with the above in-house requirement. As the bagasse percentage in cane is quite high, even after meeting with the requirements of the operation of the new Cogeneration plant there will be some surplus bagasse left. This surplus bagasse will be used for the operation of the Cogeneration plant during the maintenance days and also during the off-crop period. Once the Cogeneration plant is commissioned even if the sugar mill stops for maintenance work, the power plant will keep running. During such periods of running, there will be no requirement of process steam and the

Cogeneration plant will essentially operate in a condensing mode and will generate power to supply in national grid.

1.2 Auxiliary Plant and Equipment

- Fuel handling
- Ash handling
- Cooling Tower
- Pumps
- Condensate System
- DM / RO Plant
- Crane for the Turbogenerator Building
- Vessels & Heat Exchangers
- Tanks
- Compressed Air System

1.2.1 Piping

All piping system shall be designed as per prescribed standard. In addition, statutory requirements of Pakistan Boiler Regulations shall be complied with. All piping shall be sized considering the allowable velocity and allowable pressure drop in the system.

1.2.2 Insulation

All exposed portions of the plant which operate at temperatures of 60°C and above during normal operation shall be thermally insulated so that the temperature on the outer surface of the cladding shall not exceed by more than 20°C above ambient, based on an ambient temperature indicated in site data. The specified insulation thickness shall not include the thickness of wire netting, finishing cement or any other finishing or weatherproofing application. Insulation shall not fill the contours of the expansion bellows. Piping and equipment that are not insulated but having a surface temperature

exceeding 50 °C shall be insulated for personnel protection. In refractory walls suitable expansion gaps shall be provided at regular intervals.

1.2.3 Ventilation System and Air Conditioning system

The following areas will be envisaged with exhaust ventilation system:

- TG hall
- Water Treatment plant Equipment room
- Chemical Storage area in WTP (water treatment plant) building
- Muffle furnace, Hot oven, etc room in WTP building
- WTP MCC panel room
- Fire Pump House
- Toilets

The exhaust ventilation system will maintain the temperature rise within 5 °C above ambient temperature.

The following areas of power plant will be envisaged with Ductable type, ceiling suspended air conditioning system:

Auxiliary MCC panel rooms in TG building
Control Room in TG building
Battery room

The following areas of power plant will be envisaged with Hi-Wall split air conditioning system:

SWAS panel room in TG building
WTP DCS operator station room in WTP building
WTP laboratory room in WTP building
Office and Conference Room

The air conditioning system will maintain a temperature of 22 ° C inside the rooms.

1.2.4 Fire Fighting System

The following fire fighting systems will be envisaged for the power plant:

Fire Hydrant system for the entire power plant including fuel storage areas.

Automatic Fire detection and alarm system for the TG building
Portable Fire extinguishers for the TG building.

High Velocity water spray system for Switch Yard Transformer

The fire hydrant system shall consist of two numbers of pumps (one working and one standby). The main pump will be of diesel engine driven and standby pump will be of electrical motor driven. In addition to the above two pumps, there will be an electrical motor driven jockey pump. The fire hydrants, water monitor, hoses and nozzles shall be located throughout the power plant. All the fire water pumps shall be located near raw water reservoir in cogeneration plant taking suction from the raw water reservoir. The suction for the other pumps drawing water from the raw water reservoir will be located such a way that the minimum storage of water in the reservoir will be maintained for meeting the fire water requirements.

The fire alarm system shall consist of smoke detectors, heat detectors, fire alarm panel, hooter, manual call point etc. The detectors shall be located in all the electrical panel rooms, control room and battery room. The manual call point and hooters shall be located throughout the entire TG building. The detectors will sense the fire automatically and will generate fire alarm through Fire alarm panel.

The portable fire extinguishers shall consist of dry chemical powder type, carbon-di-oxide type, foam type fire extinguishers. The extinguishers shall be located strategically inside the TG building.

2.0 Plant and Machinery (Mechanical) for Cogeneration Plant

2.1 General

2.1.1 The plant and machinery (mechanical) for the cogeneration plant shall be as follows:-

- Steam Generating system
- Steam Turbines and Auxiliary System
- High Pressure Feed Water Heater
- Crane for The Turbogenerator Building
- Fuel Handling System
- Ash Handling System
- Water system
- DM Water System
- Service And Potable Water System
- Compressed Air System
- Air Conditioning System
- Ventilation System
- Fire Protection System
- Main Steam, Medium Pressure and Low Pressure Steam Systems

3.0 Plant and Machinery (Electrical) for Cogeneration Plant

3.1.1 The proposed new cogeneration plant at DGL will generate power at 11kV voltage level which will be upgraded to 132kV level for dispersal of power to national grid. For the purpose a 132kV switchyard shall be constructed. The plant and machinery (electrical) for the cogeneration plant shall include:-

Generator
Excitation System & Synchronizing Panels
Unit Control Panel
LAVT and NGR Cubicles
11 kV Switchgear Panel
Distribution System
Plant Auxiliary Transformers and LT Panels
D.G Set for Emergency power requirement
Earthing System
Cables
DC supply system
AC Auxiliary Supply
Lighting System
Lightning Protection
Plant Communication system
Suitability of power unit to operate in parallel with grid
Generator Transformer
Circuit breakers
Protection, metering & control cubicles
Lightning Arrestors
Isolators & Insulators
Instrument transformers
Structures
Safety Earthing System for switchyard

4.0 Instrumentation and Control System

4.1 General

This Section of the Report gives the general philosophy of the Instrumentation and Control system for the new Cogeneration Power Plant.

The objectives of Instrumentation & Control system design are as follows.

a. To ensure maximum availability of the plant
b. To effectively monitor and control the plant to ensure desired efficiency levels.
c. To ensure plant and personnel safety and reduce down time
d. To provide necessary information to management personnel regarding overall plant performance
e. To have self diagnostics& faster response time
f. To be user friendly for operation and maintenance personnel

Centralized control and monitoring with provision for local intervention wherever necessary is the essence of the design philosophy.

Modular design concept will be adopted to ensure that single defective equipment will not disturb functioning of overall system.

The plant will be complete with the basic instrumentation and control system necessary for its safe and efficient operation.

Comprehensive instrumentation and control equipment will be provided for each major area of the plant i.e. Boilers, Turbo - generators, etc.

4.2 Design Criteria

The control system shall be based on the State-Of-The-Art Distributed Control System (DCS) technology with Data Acquisition and control of the entire plant operational parameters.

For critical automatic control loops, redundant transmitters will be provided with 2 out of 3 logic to improve reliability / availability. All other control loops shall be provided with 1 out of 2 logic.

System configuration will be such that any single point failure will not affect the continuous operation of the plant. Redundancy will be provided at appropriate levels to ensure maximum system availability.

5.0 Site Features and Plant Layout

5.1 Location and Features of the Plant Site

The proposed Cogeneration plant at DGL, will be located within the premises of DSML's sugar plant complex. This complex presently consists of only the sugar plant.

The following specific features of the site have been discussed in this section of the report.

- Availability of adequate space for locating the Cogeneration plant, bagasse storage and adequate space for the construction activities.
- Suitability of the site from topographical and geological considerations.
- Availability of road connections for material movements.

- Availability of adequate quantity of water for meeting the plant's water requirements.
- Availability of adequate fuel and its transport.
- Interconnection with Grid.
- Ecological Impact.

5.1.1 Space Availability

Adequate land is available within the sugar plant premises for locating the Cogeneration plant. Logistically the Cogeneration plant has to be located close to the sugar plant as the steam for the processing of sugar has to be supplied from the turbine extractions, the power for the sugar plant operations has to be supplied from the HT panels of the Cogeneration plant, and the bagasse from the sugar plant has to be supplied to the Cogeneration plant. Keeping the plant away from the sugar plant will result in more capital cost towards the piping, cables and bagasse conveyors.

In the area identified for the Cogeneration plant, adequate space is available for the construction activities during the installation period of the plant and there will not be any hindrance to the operation of the sugar plant during the construction period. Allocation of construction space will be based on the requirements to be given by the Contractors. However, detailed topographical survey will be made during the detailed engineering stage.

5.1.2 Topographical and Geological Aspects

The area identified for the Cogeneration plant is almost flat and does not much of levelling. The level difference between the existing sugar plant and cogeneration area, if any, will be taken care of appropriately in the detailed engineering stage.

5.1.3 Rail and Road Facilities

All plant and machinery has to be transported only by road. All the imported equipment have to be brought to the port of Karachi and then transported by road. The Plant is located at Taluka Digri, District Mirpur Khas. Road connectivity to the plant is very good.

5.1.4 Water Availability

The raw water for the Cogeneration plant is required for meeting the following requirements.

- Make up water to the Steam Generator.
- Make up water to the Cooling Tower.
- Ash disposal.
- Other Plant services

The water availability is through the bore wells in the plant. Presently the requirements of the sugar mill are being met only from this bore wells.

5.1.5 Availability of Fuel

The proposed Cogeneration plant operation will be based on the in house generation of Bagasse in the sugar plant, & biomass fuels. Bagasse is generated in-house from the cane received at the sugar mill. The biomass fuels will be transported for the operation of the plant.

5.1.6 Interconnection with Grid

It is proposed to step up the generation voltage of 11 kV to 132 kV and to parallel with the National grid at 132 kV level. The 132 kV transmission lines from the Cogeneration plant's

switchyard will be connected to the Electricity Transmission Company's 132 kV Sub-station at Digri.

5.2 Project Schedule

5.2.1 The schedule envisages the project commissioning and synchronization in Twenty two (22) months from the date of release of advance payment to Supply Contractor. The proposed COD date will be 18 months after financial close i.e in March, 2019. Civil, erection and other activities in DGL's scope shall be ordered after finalisation of design.

5.2.2 For the packages in DGL's scope, the schedule includes the following applicable activities.

a) Basic Study
b) Tendering
c) Receipt of offers, evaluation, discussions and Purchase order placement.
d) Construction, Erection and other work at site
e) Commissioning, trial run and testing

5.2.3 In the proposed Cogeneration plant the boiler and the turbogenerator are the long lead items and the planning of the schedule for the project implementation should provide adequate time period for the installation of these equipment.

5.2.4 Once the project gets started, it is essential that a more detailed bar or network chart is prepared incorporating all the contract activities, so that the planning and the monitoring is effectively carried out.

6.0 Project Cost Estimate

6.1 Methodology of the EPC Cost estimate

It is assumed that the project will be executed through the package route with the Supply Contractor carrying out the Engineering, Procurement and Construction Management activities. The Supply Contractor shall make the basic design of the plant, prepares the specifications and assists DGL in the finalisation of the packages. Once the packages are ordered, the Supply Contractor shall expedite with the contractors, reviews drawings, co-ordinate all the activities between the contractors and manage the implementation of the project. The complete Cogeneration plant civil works will be executed by a local contractor.

Due to the current economic conditions in most of the countries, the prices of engineering goods have not registered any appreciable increase and this probably may be the best time for capital investments. Another major advantage today is that the most of equipment suppliers do not have comfortable order book positions and consequently we can expect a shorter delivery of the equipment. While the commodity prices have come down slightly the cost of other input like energy and manpower had been continuously on the uptrend. Supply Contractor has vast experience in the implementation of these bagasse based Cogeneration projects both in India and in other countries.

6.2 Installed Project Cost

The Project Cost for the implementation of the 25 MW cogeneration plant at DGL, has been estimated as US$ 31.25 Million.

6.4 Arrangement of Funds

The funds shall be arranged through DGL's equity and debt @ 20% and 80% respectively following the provisions provided in the Upfront Tariff determined by National Electric Power Regulatory Authority (NEPRA) for new Bagasse based Cogeneration Projects in May 2013 (modified in July, 2015).

Report No. PPI-261.1-Draft/17

INTERCONNECTION STUDY

For

25 MW Cogeneration Power Project by Digri-Gen Limited Located at Digri Sugar Mills, Taluka Digri, District Mirpurkhas, Sindh

Draft Report
(April 2017)

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Executive Summary

- The Draft Report for interconnection of 25 MW Digri-Gen Limited (DGL) Bagasse based Cogeneration Power Plant with HESCO grid system is submitted herewith.
- Digri-Gen Limited would like to go for high pressure cogeneration with the aim of exporting a maximum of 21.5 MW electrical power to the national grid.
- The study objective, approach and methodology have been described and the plant's data received from the Client is validated.
- This study is carried out for Digri-Gen Limited (located at Digri Sugar Mills Limited, Taluka Digri in District Mirpurkhas) in integration with five other newly proposed bagasse based cogeneration power plants in the network of HESCO. Two out of these five PPs namely Mehran Energy Limited and Tay Powergen (PVT) Limited lie in District Tando Allah Yar. Mirpurkhas Energy Limited is located in District Mirpurkhas whereas Habib Sugar Mills' PP is located in Benazir Abad District. Faran Power Limited is located in the District of Tando Muhammad Khan. The network around the plant site at 132 kV and 11 kV has been modeled as shown in Appendix-B.
- The nearest HESCO grid facility available for interconnection to Digri-Gen PP would be HESCO's 132 kV Grid Station Digri.
- Keeping in view the location of Power Project, it is proposed to connect Digri-Gen Limited via a direct double circuit from the 132kV substation of power plant to HESCO's 132kV Grid Station Digri. The length of each line would be 7 km and the conductor used would be Lynx. The scheme is shown in Sketch-2 in Appendix-B.
- Digri-Gen PP would generate power at 11 kV voltage level from where it is stepped-up to 132 kV using two 132/11 kV transformers with rating of 28/35 MVA. Percentage Reactance of these step-up transformers is proposed to be 15% on ONAN base.
- The proposed scheme would require two 132 kV line bays at the 132 kV substation of Digri-Gen Limited for the connection to HESCO's 132kV Grid Station Digri. Furthermore it would also require two transformer bays for the connection of two 132/11 kV transformers with rating of 28/35 MVA.

- ❖ With the gross capacity of 25 MW, the spillover from Digri-Gen PP would be 21.5 MW in Off-Season and 17.5 MW in the Crushing Season.
- ❖ In view of planned COD of Digri-Gen PP at the end of year 2018, the above proposed interconnection scheme has been tested for steady state conditions through detailed load flow studies for the following scenarios:
    - o Peak and Off-Peak Load Conditions of January 2019 for maximum thermal power dispatches in the grid during the Crushing Season for Digri-Gen PP.
    - o Peak Load Conditions of Summer 2019 for maximum hydropower dispatches in the grid during the off-season for Digri-Gen PP.

  The system conditions of normal and N-1 contingency have been studied to meet the reliability criteria of NEPRA Grid Code.
- ❖ The proposed scheme of interconnection has also been tested for the extended term scenario of peak load conditions of summer 2021 for steady state conditions.

Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the spillover of up to 21.5 MW power of the Plant under normal as well as contingency conditions.

The short circuit analysis has been carried out to calculate maximum fault levels at Digri-Gen PP and the substations of 132 kV in its vicinity. We find that the fault currents for the proposed scheme are within the rated short circuit capacities of switchgear installed at these substations. There are no violations of exceeding the rating of the equipment due to contribution of fault current from Digri-Gen PP. The maximum short circuit levels of Digri-Gen PP 132 kV are 3.69 kA and 3.44 kA for 3-phase and 1-phase faults respectively for the year 2019. The same values for the year 2021 are 3.70 kA and 3.45 kA. It would be advisable to go for standard size switchgear of short circuit rating of 40 kA for the 132kV and 11kV bus bars at substation of Digri-Gen. It would provide large margin for any future increase in short circuit levels due to future generation additions and network reinforcements in this area.

The dynamic stability analysis of proposed scheme of interconnection has been carried out for January 2019. The stability check for the worst case of three phase fault right on the 132 kV bus bar of Digri-Gen Ltd. substation followed by the

final trip of one 132 kV circuit emanating from this substation, has been performed for fault clearing of 5 (100 ms) and 9 cycles (180 ms), in case of stuck breaker, as understood to be the normal fault clearing time of 132 kV protection system. The stability of system for far end faults of 3-phase occurring at 132 kV bus bar have also been checked. The proposed scheme successfully passed the dynamic stability checks for near and far faults for the most stringent cases. The system is found strong enough to stay stable and recovered with fast damping.

- The proposed scheme of interconnection has no technical constraints or problems, it fulfills all the criteria of reliability and stability under steady state load flow, contingency load flows, short circuit currents and dynamic/transient conditions; and is therefore recommended to be adopted.

Report Contents

1. Introduction

1.1 Background

Digri-Gen Limited PP would like to go for high pressure cogeneration with the aim of exporting spillover power to the National Grid. The electricity generated from this project would be supplied to the grid system of HESCO through 132 kV grids available in the vicinity of this project. The nearest grid facility is HESCO's 132kV Grid Station Digri as shown in Sketch-1 in Appendix-B.

1.2 Objectives

The overall objective of the Study is to evolve an interconnection scheme between Digri-Gen PP and HESCO network, for stable and reliable evacuation of the electrical power generated from this plant, fulfilling N-1 reliability criteria. The specific objectives of this report are:

1. To develop scheme of interconnections at 132 kV for which right of way (ROW) and space at the terminal substations would be available.
2. To determine the performance of interconnection scheme during steady state conditions of system, normal and N-1 contingency, through load-flow analysis.
3. To check if the contribution of fault current from this new plant increases the fault levels at the adjoining substations at 132 kV voltage levels to be within the rating of equipment of these substations, and also determine the short circuit ratings of the proposed equipment of the substation at Digri-Gen PP.
4. To check if the interconnection withstands dynamic stability criteria of post fault recovery with good damping.

1.3 Planning Criteria

The planning criteria required to be fulfilled by the proposed interconnection is as follows:

Steady State:

Voltage	± 5 %, Normal Operating Condition
	± 10 %, Contingency Conditions
Frequency	50 Hz Nominal
	49.8 Hz to 50.2 Hz variation in steady state
	49.4 - 50.5Hz, Min/Max Contingency Freq. Band

Short Circuit:

Substation Equipment Rating for 132 kV should be 31.5 kA or 40 kA.

Dynamic/Transient:

The system should revert back to normal condition after dying out of transients without loosing synchronism with good damping after permanent three-phase fault on any primary transmission element; including: transmission circuit, substation bus section, transformer, or circuit breaker. It is assumed that such a fault shall be cleared by the associated circuit breaker action in 5 cycles.

In case of failure of primary protection (stuck breaker case), the total fault clearing time from the instant of initiation of fault current to the complete interruption of current to isolate the faulted element, including the primary protection plus the backup protection to operate and isolate the fault, is equal to 180 ms (9 cycles) for 132 kV and higher voltage levels.

Date: 22-5-2017

Dy. General Manager-II
CPPA-G,
Enercon Building, Ground Floor, G-5/2
Near State Bank,
Islamabad.

Subject: Grid Interconnection Studies of 25 MW Bagasse Co-Generation Power Project, Digri, District Mirpur Khas, Sindh

Sir,

Please find herewith for your review and vetting of Draft Report of Grid Interconnection Studies for 25 MW Bagasse Co-Generation Power Project, Digri, District Mirpur Khas, Sindh.

The Report includes all the necessary studies required for the feasibility of interconnection with the main grid as follows;

1. Load flow analysis
2. Short circuit analysis
3. Dynamic and Transient stability analysis

We request you to please expedite the review and vetting as we are moving fast to achieve all the targets of Financial Close to start the project ASAP.

Thanks and best regards.

Ahaidh Hassan Mohammad Javeri
(CEO Digri-Gen Limited)

CC:

1: CEO, HESCO Headquarter, WAPDA Complex, Hussainabad Hyderabad Sindh
2: Chief Engineer (P&E) HESCO Headquarter, WAPDA Complex, Hussainabad Hyderabad Sindh alongwith 01 copy of the draft report
3: Power Planners International, 64 – F/1, Wapda Town, Lahore

HESCO [illegible] ELECTRIC SUPPLY COMPANY

[illegible] Phone No. [illegible] 9260 070 [illegible]

[illegible] HESCO [illegible]

Chief Engineer (P&E) [illegible]
HESCO, Hyderabad

Subject: **Request for Sharing Data / Information for Grid Interconnection Study in Respect of M/s Digri Gen Limited District Mirpurkhas**

Reference: Your letter No. CEO/HESCO/CE(P&E)/DM(SPP)/4 [illegible] dated [illegible]

1. Sequel to above referred letter, M/s PPI Lahore is hereby allowed to use the HESCO's transmission system data / information (PSS/E files) for grid interconnection study for 25 MW (Gross) Bagasse Based Co-generation Power Project in respect of M/s Digri Gen Limited District Mirpurkhas. M/s PPI, Lahore should ensure the utilization of actual and accurate data / information.

2. However, M/s PPI is also advised not to use the system data / information for any other study nor should it be provided to any other company including the sponsor of the above mentioned power plant without the prior permission of HESCO, Hyderabad.

Chief Engineer (Dev),
Project Management Unit,
HESCO, Hyderabad

C.C. to:
1. PSO to Chief Executive Officer, HESCO, Hyderabad.
2. Master File.

2. Technical Data

The number of generating units at Digri-Gen PP is one. The following data have been provided by the Client:

2.1 Digri-Gen PP data

Generator data:

Gross capacity of power plant	= 1x25 = 25 MW
Lump sum MVA capacity	= 1x31.25 = 31.25 MVA
Generating Voltage	= 11 kV
Power factor	= 0.80 lagging

Crushing Season:

Load + Auxiliary Consumption	= 7.5 MW
Spillover to the Grid	= 17.5 MW

Off-Season:

Load + Auxiliary Consumption	= 3.5 MW
Spillover to the Grid	= 21.5 MW

GSU Transformer	= 35 MVA (x2)
Proposed GSU Transformer reactance	= 15 % @ 31.5MVA base

2.2 Network data

The latest Generation Expansion Plan and Load Forecast has been used as provided by NTDC and is shown in Appendix-A.

The 132 kV network in the area near Digri-Gen PP are as shown in Sketches in Appendix-B. The system data of HESCO has been used as already available with PPI.

3. Study Approach and Methodology

3.1 Understanding of the Problem

Digri-Gen Limited PP would like to go for high pressure cogeneration with the aim of exporting a maximum of 21.5 MW supply to the grid during the Off-Season and 17.5 MW in Crushing Season. The proposed Power Project is going to be embedded in the transmission network of HESCO through this nearest available 132 kV network.

The adequacy of HESCO network of 132 kV in and around the proposed site of Digri-Gen PP has been investigated in this study for absorbing and transmitting this power fulfilling the reliability criteria.

3.2 Approach to the problem

The consultant has applied the following approaches to the problem:

- A base case network model has been prepared for January 2019 (Crushing Season) and Summer 2019 (Off-Season) after the commissioning of Digri-Gen PP by the end of year 2018, comprising all 500 kV, 220 kV and 132 kV system, envisaging the load forecast, the generation additions and transmission expansions for that year particularly in HESCO.
- Month of January 2019 and Summer 2019, while representing Crushing Season and Off-Season respectively, also represent low water and high water conditions respectively in the grid system. Thus both the high water and low water flow patterns can be observed allowing us to judge the maximum impact of the plant on the transmission system in its vicinity. In addition, case for extended term scenario of the year 2021 has also been studied.
- Interconnection scheme without any physical constraints, like right of way or availability of space in the terminal substations, have been identified.
- Technical system studies for peak load conditions to confirm technical feasibility of the interconnections have been performed. The scheme will be subjected to standard analysis like load flow, short circuit, and transient stability study to check the strength of the machines and the proposed interconnection scheme under disturbed conditions.

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

4. Development of Scheme of Interconnection

4.1 The Existing and Ongoing Network

Digri-Gen Limited is located near HESCO's 132kV Grid Station Digri, District Mirpurkhas embedded in the distribution network of HESCO. The existing 132 kV network available around Digri is shown in Sketch-1 in Appendix-B. The nearest interconnection facilities of HESCO at time of commissioning of Digri-Gen PP would be as follows:

- 132 kV Digri-Gen Grid Station

There is a strong 220 kV network in the vicinity connecting Hala Road 220/132 kV grid station with Jamshoro 220 kV, T.M.Khan 220 kV and Mirpur Khas 220 kV substations. A strong system helps in stable operation of a power plant.

4.2 The Scheme of Interconnection of Digri-Gen PP

Keeping in view of the above mentioned 132 kV network available in the vicinity of the site of the Digri-Gen PP, the interconnection scheme for Digri-Gen PP has been developed. According to the new scheme, it is proposed to connect Digri-Gen Limited via double circuit to the existing Transmission Line from HESCO's 132kV Grid Station Digri. The length as confirmed from site visit would be 7 km and the conductor used would be Lynx. The scheme is shown in Sketch-2 in Appendix-B. The network of Digri has been modeled at 132 kV and 11 kV.

5. Detailed Load Flow Studies

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

5.1 Peak Load Case January 2019, without All PPs

A base case has been developed for the peak load of January 2019 using the network data of NTDC and HESCO available with PPI, after updating with latest load forecast and expansion plan of NTDC and HESCO. The peak load of the year 2018-19 for HESCO has been modeled as per the latest PMS Demand forecast obtained from NTDC. It is attached in Appendix-A.

In this scenario none of the five newly proposed PPs is considered. The results of load flow for this base case are plotted in Exhibit 0.0 of Appendix-C. The system plotted in this Exhibit comprises of 132 kV network feeding Hala Road, Samaro, Mir Wahg, Mirpurkhas, Tando Jam, Tando Allah Yar, Chamber and the surrounding areas.

The load flow results show that the power flows on all the circuits are within their normal rating. The voltage profile of these surrounding substations is also within normal limits.

For N-1 contingency conditions we have performed the following cases

Exhibit - 0.1	T.G ALi to Digri 132 kV Single Circuit Out
Exhibit - 0.2	Digri to T.Jan MO 132 kV Single Circuit Out
Exhibit - 0.3	T.Jan MO to Noukot 132 kV Single Circuit Out
Exhibit - 0.4	MPKHAS-2 to Samaro 132 kV Single Circuit Out
Exhibit - 0.5	Mirpurkhas to MPKHAS-2 132 kV Single Circuit Out
Exhibit - 0.6	Usman Shah H to Mirpurkhas 132 kV Single Circuit Out
Exhibit - 0.7	HalaRoad to Usman Shah H 132 kV Single Circuit Out

We see that in all the cases the power flows on all circuits remain within their rated limit. Also the bus voltages are within the acceptable operating range.

5.2 Peak Load Case January 2019, without Digri PP

Base case of January 2019 earlier prepared was used and four PPs i.e. Tay Powergen (PVT) Ltd., Faran Power Limited, Mehran Energy Limited and Mirpurkhas Energy Limited were modeled in the case as per proposed interconnection scheme that was finalized after conducting site visits of all the Sugar Mills. Since the COD of Habib Sugar Mills PP is August 2019 hence it is not considered in the scenario of January 2019.

The results of load flow for this case of Without Digri-Gen PP are plotted in Exhibit 1.0 of Appendix-C. The load flow results show that the power flows on all the circuits are within their normal rating. The voltage profile of these surrounding substations is also within normal limits.

For N-1 contingency conditions we have performed the following cases

Exhibit - 1.1	T.G Ali to Digri 132 kV Single Circuit Out
Exhibit - 1.2	Digri to T.Jan MO 132 kV Single Circuit Out
Exhibit - 1.3	T.Jan MO to Noukot 132 kV Single Circuit Out
Exhibit - 1.4	MPKEL-PP to Samaro 132 kV Single Circuit Out
Exhibit - 1.5	Mirpurkhas to MPKHAS-2 132 kV Single Circuit Out
Exhibit - 1.6	MEL-PP to Mirpurkhas 132 kV Single Circuit Out
Exhibit - 1.7	HalaRoad to Usman Shah H 132 kV Single Circuit Out

We see that in all the cases the power flows on all circuits remain within their rated limit. Also the bus voltages are within the acceptable operating range.

5.3 Peak Load Case January 2019, with Digri-Gen PP in Crushing Season

The scheme of interconnection modeled in the load flow for Digri PP is as described in Chapter-4. In this scenario four PPs as discussed above are also modeled.

Load flow studies have been carried out for January 2019 because it represents the maximum thermal power dispatch conditions in the grid during the Crushing Season condition for Digri-Gen PP. Thus the loading on the lines in the vicinity of Digri-Gen PP will be maximum, allowing us to judge the maximum impact of the plant on the transmission system in its vicinity. The results of load flow with Digri-Gen PP interconnected as per proposed scheme are shown in Appendix-C.

The results of Normal case of this scenario are plotted in Exhibit 2.0. We find no capacity constraints on 132 kV circuits under normal conditions i.e. without any outages of circuits.

The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of ± 5 % off the nominal.

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

Exhibit - 2.1	Digri 132/11 kV Single Transformer Out
Exhibit - 2.2	Digri-Gen Ltd to Digri 132 kV Single Circuit Out
Exhibit - 2.3	T.G Ali to Digri 132 kV Single Circuit Out
Exhibit - 2.4	Digri to T.Jan MO 132 kV Single Circuit Out
Exhibit - 2.5	T.Jan MO to Noukot 132 kV Single Circuit Out
Exhibit - 2.6	MPKEL-PP to Samaro 132 kV Single Circuit Out
Exhibit - 2.7	Mirpurkhas to MPKHAS-2 132 kV Single Circuit Out
Exhibit - 2.8	MEL-PP to Mirpurkhas 132 kV Single Circuit Out
Exhibit - 2.9	HalaRoad to Usman Shah H 132 kV Single Circuit Out

We see that in all the contingency cases, in the event of outage of any circuit, the intact circuits remain within the rated capacity. Also the bus bar voltages are well within the permissible limits in all the contingency events.

5.4 Off-Peak Load Case January 2019, with Digri-Gen PP in Crushing Season

Off-Peak Load Case for the same month of January 2019 is studied to test the system under light load conditions after the addition of four newly proposed PPs in the network.

The results of this scenario are plotted in Exhibit 3.0. We find no capacity constraints on 132 kV circuits under normal conditions i.e. without any outages of circuits.

The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of ± 5 % off the nominal.

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

Exhibit - 3.1	Digri 132/11 kV Single Transformer Out
Exhibit - 3.2	Digri-Gen Ltd to Digri 132 kV Single Circuit Out
Exhibit - 3.3	T.G Ali to Digri 132 kV Single Circuit Out
Exhibit - 3.4	Digri to T.Jan MO 132 kV Single Circuit Out
Exhibit - 3.5	T.Jan MO to Noukot 132 kV Single Circuit Out
Exhibit - 3.6	MPKEL-PP to Samaro 132 kV Single Circuit Out
Exhibit - 3.7	MPKHAS-2 to Mirpurkhas 132 kV Single Circuit Out
Exhibit - 3.8	MEL-PP to Mirpurkhas 132 kV Single Circuit Out
Exhibit - 3.9	Hala Road to Usman Shah H 132 kV Single Circuit Out

We see that in all the contingency cases, in the event of outage of any circuit, the intact circuits remain within the rated capacity. Also the bus bar voltages are well within the permissible limits in all the contingency events.

5.5 Peak Load Case January 2019, with Digri-Gen PP without other PPs

Digri-Gen PP is modeled as per proposed interconnection scheme described in Chapter-4. In this scenario other new PPs are not considered.

The results of Normal case of this scenario are plotted in Exhibit 4.0. We find no capacity constraints on 132 kV circuits under normal conditions i.e. without any outages of circuits.

The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of ± 5 % off the nominal.

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

Exhibit - 4.1	Digri 132/11 kV Single Transformer Out
Exhibit - 4.2	Digri-Gen Ltd to Digri 132 kV Single Circuit Out
Exhibit - 4.3	T.G Ali to Digri 132 kV Single Circuit Out
Exhibit - 4.4	Digri to T.Jan MO 132 kV Single Circuit Out
Exhibit - 4.5	T.Jan MO to Noukot 132 kV Single Circuit Out
Exhibit - 4.6	MPKHAS-2 to Samaro 132 kV Single Circuit Out
Exhibit - 4.7	Mirpurkhas to MPKHAS-2 132 kV Single Circuit Out
Exhibit - 4.8	Usman Shah H to Mirpurkhas 132 kV Single Circuit Out
Exhibit - 4.9	Hala Road to Usman Shah H 132 kV Single Circuit Out

We see that in all the contingency cases, in the event of outage of any circuit, the intact circuits remain within the rated capacity. Also the bus bar voltages are well within the permissible limits in all the contingency events.

5.6 Peak Load Case Summer 2019, with Digri-Gen PP in Off-Season

Load flow studies have also been carried out for summer season because it represents the maximum hydropower dispatch conditions in the grid during the Off-Season for

Digri-Gen PP. In this scenario all five PPs including Habib Sugar Mills PP are considered. The results of load flow with Digri-Gen PP interconnected as per proposed scheme are shown in Appendix-C.

The results of Normal case of Peak Summer 2019 are plotted in Exhibit 5.0. We find no capacity constraints on 132 kV circuits under normal conditions i.e. without any outages of circuits.

The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of ± 5 % off the nominal.

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

Exhibit – 5.1	Digri 132/11 kV Single Transformer Out
Exhibit - 5.2	Digri-Gen Ltd to Digri 132 kV Single Circuit Out
Exhibit - 5.3	T.G Ali to Digri 132 kV Single Circuit Out
Exhibit - 5.4	Digri to T.Jan MO 132 kV Single Circuit Out
Exhibit - 5.5	T.Jan MO to Noukot 132 kV Single Circuit Out
Exhibit - 5.6	MPKEL-PP to Samaro 132 kV Single Circuit Out
Exhibit - 5.7	Mirpurkhas to MPKHAS-2 132 kV Single Circuit Out
Exhibit - 5.8	MEL-PP to Mirpurkhas 132 kV Single Circuit Out
Exhibit - 5.9	Hala Road to Usman Shah H 132 kV Single Circuit Out

We see that in all the contingency cases, in the event of outage of any circuit, the intact circuits remain within the rated capacity.

Also the bus bar voltages are well within the permissible limits in all the contingency events.

5.7 Peak Load Case 2021: Extended Term Scenario

We have also studied the future scenario of Year 2021 to assess the impact of the plant in the extended term after addition of generation and other reinforcements in the system as per the generation and transmission plan of NTDC and HESCO.

The results of Normal case of Peak 2021 are plotted in Exhibit 6.0. The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of ± 5 % off the nominal.

We find no capacity constraints on 132 kV circuits under normal conditions i.e. without any outages of circuits.

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

Exhibit - 6.1	Digri 132/11 kV Single Transformer Out
Exhibit - 6.2	Digri-Gen Ltd to Digri 132 kV Single Circuit Out
Exhibit - 6.3	T.G Ali to Digri 132 kV Single Circuit Out
Exhibit - 6.4	Digri to T.Jan MO 132 kV Single Circuit Out
Exhibit - 6.5	T.Jan MO to Noukot 132 kV Single Circuit Out
Exhibit - 6.6	MPKEL-PP to Samaro 132 kV Single Circuit Out
Exhibit - 6.7	Mirpurkhas to MPKHAS-2 132 kV Single Circuit Out
Exhibit - 6.8	MEL-PP to Mirpurkhas 132 kV Single Circuit Out
Exhibit - 6.9	Hala Road to Usman Shah H 132 132 kV Single Circuit Out

The power flows on the circuits are seen well within the rated capacities and the voltages on the bus bars are also within the permissible operating range of ± 10 % off the nominal for contingency conditions' criteria

We find that there are no capacity constraints in the proposed connectivity scheme of Digri-Gen PP.

5.8 Conclusion of Load Flow Analysis

Different Load flow scenarios were studied for this integrated study of five newly proposed Bagasse based Co-gen Power plants. It is concluded that the proposed interconnection scheme of Digri-Gen PP is adequate to evacuate the spillover electrical power from Digri-Gen PP under normal and contingency conditions tested for peak and off-peak load conditions of January 2019, peak load conditions of summer 2019 and an extended term scenario of the Year 2021. In all the normal and contingency cases, we find that the loading on the circuits remain within the rated capacity. Also the bus bar voltages are well within the permissible limits in all the

normal and contingency events. Hence, the proposed interconnection scheme of Digri-Gen PP has no constraints according to the Load Flow Analysis.

6. Short Circuit Analysis

6.1 Methodology and Assumptions

The methodology of IEC 909 has been applied in all short circuit analyses in this report for which provision is available in the PSS/E software used for these studies.

The maximum fault currents have been calculated with the following assumptions under IEC 909:

- Set tap ratios to unity
- Set line charging to zero
- Set shunts to zero in positive sequence
- Desired voltage magnitude at bus bars set equal to 1.10 P.U. i.e. 10 % higher than nominal, which is the maximum permissible voltage under contingency condition.

For evaluation of maximum short circuit levels we have assumed contribution in the fault currents from all the installed generation capacity of hydel, thermal and nuclear plants in the system in the year 2019 i.e. all the generating units have been assumed on-bar in fault calculation's simulations.

The assumptions about the generator and the transformers data are the same as mentioned in Ch.2 of this report.

6.2 Fault Current Calculations without Digri-Gen PP – Year 2019

In order to assess the short circuit strength of the network of 132 kV without Digri-Gen PP for the grid of HESCO in the vicinity of the site of the Plant, fault currents have been calculated for balanced three-phase and unbalanced single-phase short circuit conditions. These levels will give us the idea of the fault levels without Digri-Gen PP and later on how much the contribution of fault current from Digri-Gen PP may add to the existing levels.

The results are attached in Appendix – D.

The short circuit levels have been calculated and plotted on the bus bars of 132 kV of substations lying in the electrical vicinity of our area of interest i-e Digri, Tando Jan Mohammad and the surrounding bus bars and are shown plotted in the Exhibit 7.0 attached in Appendix-D. Both 3-phase and 1-phase fault currents are indicated in the

Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabular output of the short circuit calculations is also attached in Appendix-D for the 132 kV bus bars of our interest. The total maximum fault currents for 3-phase and 1-phase short circuit at these substations are summarized in Table 6.1. We see that the maximum fault currents do not exceed the short circuit ratings of the equipment at these 132 kV substations which normally are 20 kA, 25 kA or 31.5 kA for older substations and 40 kA for new substations.

Table-6.1
Maximum Short Circuit Levels without Digri-Gen PP - Year 2019

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Mali New 132 kV	6.30	4.16
T.G. Ali 132 kV	4.04	2.58
Digri 132 kV	3.35	2.1
T.Jan MO 132 kV	3.22	2
Noukot 132 kV	3.38	2.06
Kunri 132 kV	4.3	2.84
Samaro 132 kV	6.16	4.3
Mirpurkhas 132 kV	14.87	11.12
Halaroad 132 kV	22.96	19.69
Hala Road -1 132 kV	16.62	14.88

6.3 Fault Current Calculations with Digri-Gen PP – Year 2019

Fault currents have been calculated for the electrical interconnection of proposed scheme. Fault types applied are three phase and single-phase at 132 kV bus bars of Digri-Gen PP itself and other bus bars of the 132 kV substations in the electrical vicinity of Digri, Tando Jan Mohammad etc.. The graphic results showing maximum 3-phase and 1-phase fault levels are indicated in Exhibit 7.1. Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bus bars of the network in the

electrical vicinity of Digri-Gen PP are placed in Appendix-D. Brief summary of fault currents at significant bus bars of our interest are tabulated in Table 6.2

Table-6.2
Maximum Short Circuit Levels with Digri-Gen PP – Year 2019

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Digri-PP 11 kV	24.72	18.41
Digri-Gen Ltd 132 kV	3.69	3.44
Matli New 132 kV	6.56	4.62
T.G. Ali 132 kV	4.39	3.32
Digri 132 kV	3.87	3.5
T.Jan MO 132 kV	3.57	2.81
Noukot 132 kV	3.6	2.51
Kunri 132 kV	4.40	3.03
Samaro 132 kV	6.26	4.45
Mirpurkhas 132 kV	14.97	11.21
Halaroad 132 kV	23.05	19.76
Hala Road -1 132 kV	16.64	14.90

Comparison of Tables 6.1 and 6.2 show slight increase in short circuit levels for three-phase and single – phase faults due to connection of Digri-Gen PP on the 132 kV bus bars in its vicinity. We find that even after some increase, these fault levels are below the rated short circuit values of the equipment installed on these substations. The maximum short circuit level of Digri-Gen PP 132 kV is 3.69 kA and 3.44 kA for 3-phase and 1-phase faults respectively.

6.4 Fault Current Calculations with Digri-Gen PP – Year 2021

Fault currents have been calculated for the electrical interconnection of proposed scheme in the year 2021. Fault types applied are three phase and single-phase 132 kV bus bars of Digri-Gen PP itself and other bus bars of the 132 kV substations in the electrical vicinity of Digri, Tando Jan Mohammad etc. The graphic results showing maximum 3-phase and 1-phase fault levels are indicated in Exhibit 7.2. Both 3-phase and 1-phase fault currents are indicated in the Exhibit which are given in polar coordinates i.e. the magnitude and the angle of the current. The total fault currents are shown below the bus bar.

The tabulated results of short circuit analysis showing all the fault current contributions with short circuit impedances on 132 kV bus bars of the network in the electrical vicinity of Digri-Gen PP are placed in Appendix-D. Brief summary of fault currents at significant bus bars of our interest are tabulated in Table 6.3

Table-6.3
Maximum Short Circuit Levels with Digri-Gen PP – Year 2021

Substation	3-Phase Fault Current (kA)	1-Phase Fault Current (kA)
Digri Lv	24.75	18.43
DGRI-GEN LTD 132 kV	3.70	3.45
Mali New 132 kV	6.56	4.64
T.G. Ali 132 kV	4.39	3.33
Digri 132 kV	3.88	3.51
T.Jan MO 132 kV	3.58	2.82
Noukot 132 kV	3.61	2.52
Kunri 132 kV	4.43	3.05
Samaro 132 kV	6.31	4.47
Mirpurkhas 132 kV	15.21	11.34
Halaroad 132 kV	23.50	20.08
Hala Road -1 132 kV	17.03	15.16

We find that the short circuit levels have increase a little more in the future scenario but are still below the rated short circuit values of the equipment installed on these substations. The maximum short circuit level of Digri-Gen PP 132 kV is 3.70 kA and 3.45 kA for 3-phase and 1-phase faults respectively. It would be advisable to go for standard size switchgear of short circuit rating of 40 kA. It would provide large margin for any future increase in short circuit levels due to future generation additions and network reinforcements in this area.

6.5 Conclusion of Short Circuit Analysis

The short circuit analysis results show that for the proposed scheme of interconnection of Digri-Gen PP there is no problem of violations of short circuit ratings of the already installed equipment on the 132 kV equipment of substations in the vicinity of Digri-Gen PP due to fault current contributions from this power house under three-phase faults as well as single phase faults.

The short circuit level of the Digri-Gen PP 132 kV is 3.69 kA and 3.44 kA for 3-phase and 1-phase faults respectively for the year 2019. The same values for the year 2021 are 3.70 kA and 3.45 kA. Therefore, industry standard switchgear of the short circuit rating of 40 kA would be fine to be installed at 132 kV switchyard of Digri-Gen PP taking care of any future generation additions and system reinforcements in its electrical vicinity and also fulfill the NEPRA Grid Code requirements specified for 132 kV Switchgear.

7. Dynamic Stability Analysis

7.1 Assumptions & Methodology

7.1.1 Dynamic Models

The assumptions about the generator and its parameters are the same as mentioned in Ch.2 of this report.

We have employed the generic dynamic models available in the PSS/E model library for dynamic modeling of the generator, exciter and the governor as follows;

Generator	GENROU
Excitation System	EXST1
Speed Governing System	TGOV1
Inertia Constant	H = 2.837 MW-sec/MVA

7.1.2 System Conditions

The proposed scheme as described in Chapter-4 has been modeled in the dynamic simulation.

All the power plants of WAPDA/NTDCL and IPPs from Tarbela to Hub have been dynamically represented in the simulation model.

7.1.3 Presentation of Results

The plotted results of the simulation runs are placed in Appendix-E. Each simulation is run for its first one second for the steady state conditions of the system prior to fault or disturbance. This is to establish the pre fault/disturbance conditions of the network under study were smooth and steady. Post fault recovery has been monitored for nine seconds. Usually all the transients due to non-linearity die out within 3-4 seconds after disturbance is cleared in the system.

7.1.4 Worst Fault Cases

Three phase faults are considered as the worst disturbance in the system. We have considered 3-phase fault in the closest vicinity of Digri-Gen PP i.e. right at the 132 kV bus bar of Digri-Gen Limited substation, cleared in 5 cycles, as normal clearing time for 132 kV i.e.100 ms, followed by a permanent trip of single 132 kV circuit emanating from this substation.

7.2 Dynamic Stability Simulations' Results with Digri-Gen PP in Crushing Season, Year 2019

Faults were applied on 132 kV bus bars, followed by clearing of fault in 5 cycles (100 ms) or 9 cycles (180 ms) and then tripping of a circuit between the faulted bus and a nearby grid station. Different quantities were monitored for one second pre-fault and nine seconds after clearance of fault (post-fault) conditions and the results are plotted in Appendix – E. These fault locations and monitored quantities are discussed one by one as follows;

7.2.1

Fault Location: Three Phase Fault at Digri-Gen Limited 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Digri-Gen Limited to Digri 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Digri-Gen Ltd 132 kV 2. Digri-LV 11 kV 3. Digri 132 kV 4. T.G.Ali 132 kV 5. T.Jan.Mo 132 kV 6. Matli New132 kV	The voltages of all the bus bars recover after fault clearance	1.1
Frequency	Digri-LV 11 kV	Recovers after fault clearance	1.2
MW/MVAR Output of the Plant	Digri-LV 11 kV	Recovers after damping down oscillations	1.3
Speed and $P_{mechanical}$ of the Plant	Digri-LV 11 kV	Recovers after damping down oscillations	1.4
Line Flows (MW/MVAR)	Digri-Gen Ltd to Digri 132 kV single circuit	Attains steady state value after damping of oscillations	1.5
Rotor Angles	1. Digri LV 11 kV 2. T.A.Yar PP 11 kV 3. MPKEL 11 kV 4. MEL 11 kV 5. FPL 11 kV 6. Hub 500 kV (reference angle)	Damps down and attain a steady state value	1.6

7.2.2

Fault Location: Single Phase Fault at Digri-Gen Limited 132 kV bus bar			
Fault Duration: 9 cycles (180 ms)			
Line Tripping: Digri-Gen Limited to Digri 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Digri-Gen Ltd 132 kV 2. Digri-LV 11 kV 3. Digri 132 kV 4. T.G.Ali 132 kV 5. T.Jan.Mo 132 kV 6. Matli New132 kV	The voltages of all the bus bars recover after fault clearance	2.1
Frequency	Digri-LV 11 kV	Recovers after fault clearance	2.2
MW/MVAR Output of the Plant	Digri-LV 11 kV	Recovers after damping down oscillations	2.3
Speed and $P_{mechanical}$ of the Plant	Digri-LV 11 kV	Recovers after damping down oscillations	2.4
Line Flows (MW/MVAR)	Digri-Gen Ltd to Digri 132 kV single circuit	Attains steady state value after damping of oscillations	2.5
Rotor Angles	1. Digri LV 11 kV 2. T.A.Yar PP 11 kV 3. MPKEL 11 kV 4. MEL 11 kV 5. FPL 11 kV 6. Hub 500 kV (reference angle)	Damps down and attain a steady state value	2.6

7.2.3

Fault Location: Three Phase Fault at Digri 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Digri to T.Jan.Mohammad 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Digri 132 kV 2. Digri-LV 11 kV 3. Digri-Gen Ltd 132 kV 4. T.G.Ali 132 kV 5. T.Jan.Mo 132 kV 6. Matli New132 kV	The voltages of all the bus bars recover after fault clearance	3.1
Frequency	Digri-LV 11 kV	Recovers after fault clearance	3.2
MW/MVAR Output of the Plant	Digri-LV 11 kV	Recovers after damping down oscillations	3.3
Speed and $P_{mechanical}$ of the Plant	Digri-LV 11 kV	Recovers after damping down oscillations	3.4
Line Flows (MW/MVAR)	Digri to T.G.Ali 132 kV single circuit	Attains steady state value after damping of oscillations	3.5
Rotor Angles	1. Digri LV 11 kV 2. T.A.Yar PP 11 kV 3. MPKEL 11 kV 4. MEL 11 kV 5. FPL 11 kV 6. Hub 500 kV (reference angle)	Damps down and attain a steady state value	3.6

7.3 Dynamic Stability Simulations' Results with Digri-Gen PP in Non-Crushing Season, Year 2021

Fault Location: Three Phase Fault at Digri-Gen Ltd 132 kV bus bar			
Fault Duration: 5 cycles (100 ms)			
Line Tripping: Digri-Gen Ltd to Digri 132 kV Single Circuit			
Variable	**Bus/Line**	**Response**	**Figure No.**
Voltage	1. Digri-Gen Ltd 132 kV 2. Digri-LV 11 kV 3. Digri 132 kV	The voltages of all the bus bars recover	1.1

	4. T.G.Ali 132 kV 5. T.Jan.Mo 132 kV 6. Matli New132 kV	after fault clearance	
Frequency	Digri-LV 11 kV	Recovers after fault clearance	1.2
MW/MVAR Output of the Plant	Digri-LV 11 kV	Recovers after damping down oscillations	1.3
Speed and $P_{mechanical}$ of the Plant	Digri-LV 11 kV	Recovers after damping down oscillations	1.4
Line Flows (MW/MVAR)	Digri Power Ltd to Digri 132 kV single circuit	Attains steady state value after damping of oscillations	1.5
Rotor Angles	1. Digri LV 11 kV 2. T.A.Yar PP 11 kV 3. MPKEL 11 kV 4. MEL 11 kV 5. FPL 11 kV 6. Hub 500 kV (reference angle)	Damps down and attain a steady state value	1.6

7.4 Conclusion of Dynamic Stability Analysis

The results of dynamic stability show that the system is very strong and stable for the proposed scheme for the severest possible faults of 132 kV systems near to and far of Digri-Gen PP. Therefore there is no problem of dynamic stability for interconnection of Digri-Gen PP; it fulfills all the criteria of dynamic stability.

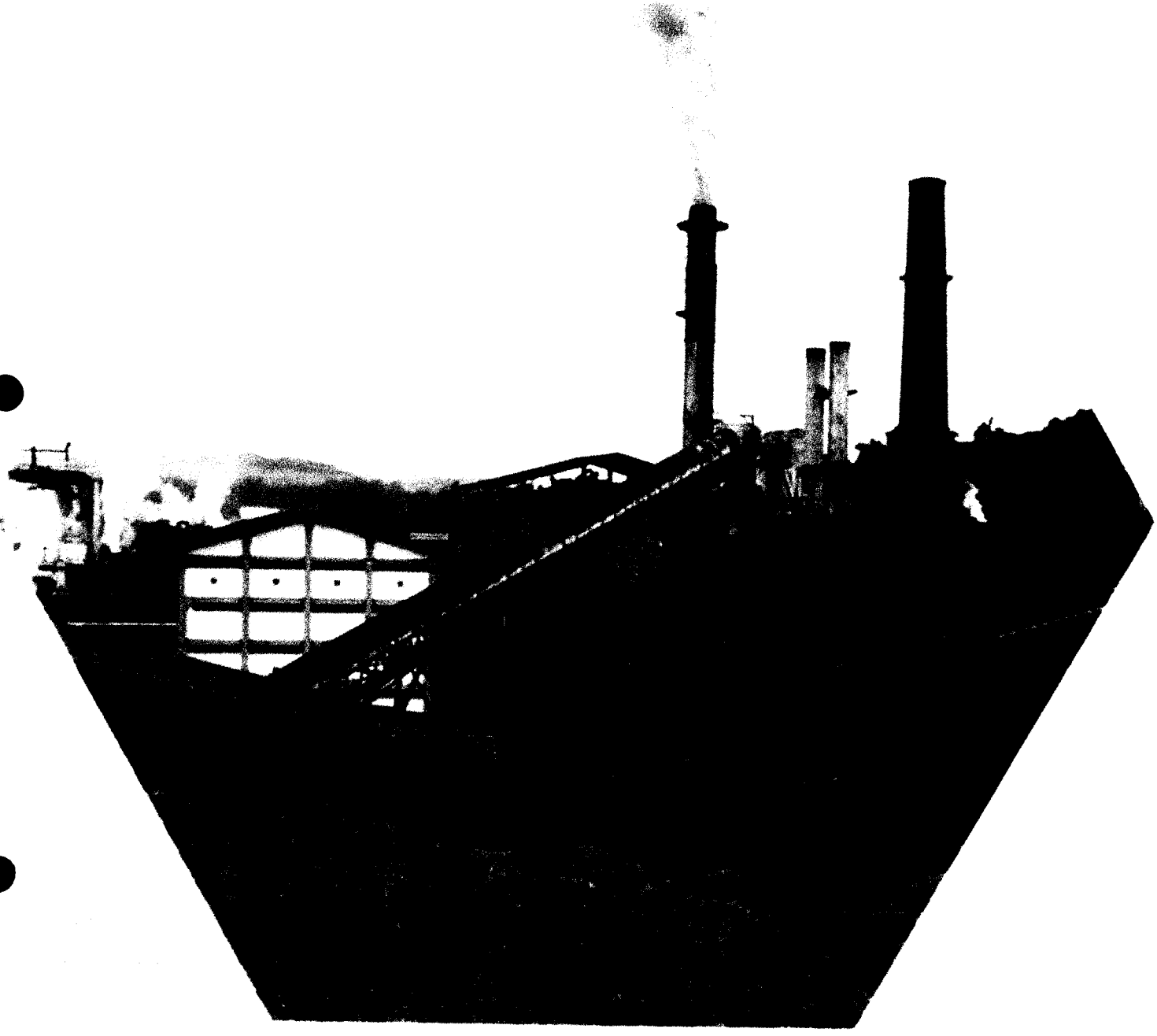
8. Conclusions

- Grid Interconnection Study for 25 MW (Gross Capacity) Digri-Gen Limited PP has been carried out which is located in District Mirpurkhas, Sindh. The nearest HESCO grid facility available for interconnection to Digri-Gen PP would HESCO's 132kV Grid Station Digri.
- Keeping in view the location of Power Project, it is proposed to connect Digri-Gen Limited via double circuit at existing HESCO's 132kV Grid Station Digri. The length as confirmed from site visit would be 7 km and the conductor used would be Lynx. The scheme is shown in Sketch-3 in Appendix-B.
- Digri-Gen PP would generate power at 11 kV voltage level from where it is stepped-up to 132 kV using two 132/11 kV transformers with rating of 35 MVA. Percentage Reactance of these step-up transformers is proposed to be 15% on ONAN base.
- The proposed scheme would require two 132 kV line bays at the 132 kV substation of Digri-Gen Limited for the connection to HESCO's 132kV Grid Station Digri. Furthermore it would also require two transformer bays for the connection of two 132/11 kV transformers with rating of 35 MVA.
- With the gross capacity of 25 MW, the spillover from Digri-Gen PP would be 21.5 MW in Off-Season and 17.5 MW in the Crushing Season.
- In view of planned COD of Digri-Gen PP that is the end of year 2018, the above proposed interconnection scheme has been tested for steady state conditions through detailed load flow studies for the following scenarios:
    - Peak and Off-Peak Load Conditions of January 2019 for maximum thermal power dispatches in the grid during the Crushing Season for Digri-Gen PP.
    - Peak Load Conditions of Summer 2019 for maximum hydropower dispatches in the grid during the off-season for Digri-Gen PP.

  The system conditions of normal and N-1 contingency have been studied to meet the reliability criteria of NEPRA Grid Code.
- The proposed scheme of interconnection has also been tested for the extended term scenario of peak load conditions of summer 2021 for steady state conditions.

- ❖ Steady state analysis by load flow for all the scenarios described above reveals that the proposed scheme is adequate to evacuate the spillover of up to 21.5 MW power of the Plant under normal as well as contingency conditions.
- ❖ The short circuit analysis has been carried out to calculate maximum fault levels at Digri-Gen PP and the substations of 132 kV in its vicinity. We find that the fault currents for the proposed scheme are within the rated short circuit capacities of switchgear installed at these substations. There are no violations of exceeding the rating of the equipment due to contribution of fault current from Digri-Gen PP.
- ❖ The maximum short circuit levels of Digri-Gen PP 132 kV are 3.69 kA and 3.44 kA for 3-phase and 1-phase faults respectively for the year 2019. The same values for the year 2021 are 3.70 kA and 3.45 kA. It would be advisable to go for standard size switchgear of short circuit rating of 40 kA for the 132kV and 11kV bus bars at substation of Digri-Gen PP. It would provide large margin for any future increase in short circuit levels due to future generation additions and network reinforcements in this area.
- ❖ The dynamic stability analysis of proposed scheme of interconnection has been carried out for January 2019. The stability check for the worst case of three phase fault right on the 132 kV bus bar of Digri-Gen PP substation followed by the final trip of one 132 kV circuit emanating from this substation, has been performed for fault clearing of 5 (100 ms) and 9 cycles (180 ms), in case of stuck breaker, as understood to be the normal fault clearing time of 132 kV protection system. The stability of system for far end faults of 3-phase occurring at 132 kV bus bar have also been checked. The proposed scheme successfully passed the dynamic stability checks for near and far faults for the most stringent cases. The system is found strong enough to stay stable and recovered with fast damping.
- ❖ The proposed scheme of interconnection has no technical constraints or problems, it fulfills all the criteria of reliability and stability under steady state load flow, contingency load flows, short circuit currents and dynamic/transient conditions; and is therefore recommended to be adopted.

DIGRI-GEN LTD



Initial Environmetnal Examination

Digri - Gen Ltd.

Digri, District Mirpurkhas, Sindh, Pakistan

Inital Environmental Examination - 2017

Digri - Gen Ltd.,

Deh 153, Taluka Digri,
District Mirpurkhas, Sindh.

Environmental Total Solutions

Office No. 1, Aqsa Tower, Gulshan-e-Iqbal,
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Email: etsnak1@gmail.com

Save Energy.
Save Money.
Save the Planet

EXECUTIVE SUMMARY

It's quite apparent that economic growth is inextricably linked to energy. As energy is tied to our economy, our future is dependent upon equitable access to energy. This in turn sets the framework of our dependence on oil and hence, why our national security is tied to securing the flow of oil.

The Government has formulated a new energy policy which envisages recommending an energy mix as a way forward where energy mix would mean regime change under which focus from thermal power will be shifted to cheaper energy production like bagasse-based power generation.

With the policy of privatization of the power industry and liberalized -schemes formulated by the Govt. of Pakistan for setting power plant by private enterprises and in view of the Energy policy as announced by State Govt. project proponent has decided to set up 26.5 MW bagasse base fired Power Plant rural area at Digri, District Mirpurkhas (Sindh) to generate power.

This report renders the relevant information, data and findings of Initial Environmental Examination (IEE) of a power plant project proposed by Digri-Gen Ltd.(DGL). DGL has appointed Environmental Total Solutions (ETS) to carry out the Initial Environmental Examination Impact of the proposed project in order to assess the environment viability of the project.

ETS successfully accomplished a profound analysis of all the possible environmental aspects pertaining to the proposed parts of the project. The study also covers Environmental study of the activities and assessment of their operational impacts on the environment.

This Initial Environmental Examination (IEE) is to provide information on the potential negative and positive environmental and social impacts of the project. It also aims to make recommendations for the mitigation of the potential negative impacts and enhancement of the positive ones. A field survey of the project site was conducted and potential environmental impacts of project activities were identified, assessed, and documented.

Both the Pakistani and World Bank's social safeguard policies have been considered during the assessment. The Initial Environmental Examination (IEE) has been prepared in compliance with the requirements of Pakistan Environmental Assessment procedures, 1997 and Pakistan.

Aim of the IEE study is to meet both the requirements of the Pakistani EIA/IEE Legislation and World Bank. For this purpose, IEE has been prepared according to the special IEE format regarding the requirements of the World Bank and Pakistani Ministry of Energy and Environment.

The main objectives of the project are to:

- Respond to the urgent need to the yawning gap between power generation and demand.
- Ensure stable power supply of 25 MW to HESCO
- Respond to the need of improvement in quality of life through sustainable power production systems.

The land available at Digri Sugar Mills site has been lease to install the power generation plant. The land has the advantage of providing the necessary infrastructure facilities including the grid for the power distribution, water, road, and telecommunication system, and involves no dismantling/construction of structures thus reducing the earthworks and associated impacts caused by extraction of materials, spoils disposal, dust emission, etc.

Categorization of the project

The project would be placed in category B, Schedule I, requiring an IEE study due to:

- Low sensitivity of the micro environment in which the 25 MW power plants is being sited, Impact of different activities including construction, installation, commissioning and operation being confined to and localized into the microenvironment of Deh 153, Taluka Digri, District Mirpurkhas, Sindh.

Summary of Findings:

Survey of the Digri-Gen Ltd. site has identified no permanent structures, residential property or other buildings, recorded culture, historical or archaeological features, which would be affected by sitting the power plant or by the project activities during construction and operation.

Soil Erosion and Contamination

The project is alive to the issues regarding soil erosion and contamination. Accordingly mitigation measures that have been adopted include allowing the existing structures as site to remain undisturbed; there is no removal of trees, erosion control measures to be installed prior to land grading, and erosion mitigation to be part of the design which will include slop stabilization measures.

Loss of top soil will be limited within the site. However, in view of the limited area of the project, this impact is expected not to be significant. Soils contamination may take place due to spillage and leakage of fuels, oils and chemicals. Possible contaminant sources include fuel, oil, and chemical storage area at campsites, and vehicles and machinery used in the field.

Drainage

Positive drainage away from the facility will, in consideration to the flat surface, have to be ensured, while the exiting drainage structure will be inspected and repaired if needed; storm channels/pipes entering structure will be grouted to ensure water tight connections, and waste water from workshops at construction and temporary camp sites will be treated using gravel and/or sand beds to remove oil and grease before its discharge into natural streams.

Air Quality

The microenvironment of the project site receives, besides the emissions from the vehicular traffic and surrounding industrial unit. in the project area.

Air Quality during Operation of Power Plant

Emission produced by bagasse operated reciprocating engine power generating sets generally meet the limits set in SEQS, except the levels of NOx. World Bank environmental guidelines recognize this problem and have set a much higher limit for NOx emissions produced by power plants. The guidelines (World Bank, 1988) suggest NOx emission limits of 2,000 mg/Nm^3 at 15% oxygen. The small diesel generators such as those to be employed during construction stage and the gas turbines of the RPPs are expected to meet the World Bank guidelines. In case do not, the proponent will introduce NOx burner in their system to comply with the World Bank guidelines, since SEQS is silent on NOx emission from gas turbines.

Noise Emission during Operation of Power Plants

Operation of the power plants generally produces noise emission levels exceeding 105 to 110 dB (A). The adverse impact is generally mitigated by enclosing the noisy units in a large enough engine hall. The gen sets will be housed in a large hall to ensure that the noise level is reduced to acceptable levels of 85 dB (A) Immediately outside the engine hall and to 70 dB (A) at the boundary wall of the RPPs.

Ecological Resources

The power plant will be located in the vicinity of Digri sugar mills and no effect on any vegetation is expected. Maintenance and regular inspection of any planted trees on roadsides will be made during the operation phase to ensure a high survival rate of saplings.

Categorization of the project

The project will be placed in Category B, Schedule I, requiring an IEE study due to:

- Low sensitivity of the microenvironment in which the 25 MW power plant is being sited,
- Impact of different activities including construction, installation, commissioning and operation being confined to and localized into microenvironment of Deh 153, Taluka Digri, District Mirpurkhas, Sindh..
- Compliance with the environmental regulations in vogue.

This IEE study has been conducted by Environmental Total Solutions an independent monitoring consultant.

Conclusion

After assessing the significance of potential impact, the environmental consultants, ETS have concluded that: "If the planned project is conducted as proposed and described in this report and the recommendation, mitigation and environmental management measures are implemented, the project activity will not result in any short and long term impact on the local community and environment

Based on conclusions of the IEE study and on the assessment made with professional judgment, it is safe to recommend approval of the findings since the proposed development meets the provisions of sustainability principles in providing the benefits of economic gains while sustainability modifying the social and physical environment.

ABBREVIATIONS AND ACRONYMS

COD	Chemical Oxygen Demand
CCGT	Combined Cycle Gas Turbine
CDM	Clean Development Mechanism
CO	Carbon monoxide
CO_2	Carbon dioxide
EBM	Environmental Base Monitoring
EMS	Environmental Management System
GHG	Greenhouse Gas (es)
HSE	Health Safety & Environment
H_2S	Hydrogen Sulfide
IEE	Initial Environmental Examination
NGOs	Non-Governmental Organization
NCS	National Conservation Strategy
NEAP	National Environmental Plan
NOx	Nitrogen oxides
PCB	Pollution Control Board
PPEs	Personnel Protective Equipment
PTW	Permit to Work
RE	Renewable Energy
RSPM	Respirable Suspended Particulate Matter
SO_2	Sulfur dioxide
T&D	Transmission and Distribution
TCD	Tones of Cane Crushed per Day
VOC	Volatile Organic Compound

TABLE OF CONTENTS

ANNEXURES

INTRODUCTION

1.1 INTRODUCTION

Energy may be needed as heat, as light, as motive power etc. The present day advancement in science and technology has made it possible to convert electrical energy into any desire form. This has given electrical energy a place of pride in the modern world. This survival of industrial undertakings and our social structure depends primarily upon low cost and uninterrupted supply of electrical energy. In fact, the advancement of country is measured in terms of per capita consumption of electrical energy.

Eighteenth-Century England gave birth to the Industrial Revolution. Four critical components provided the framework enabling the Industrial Revolution:

- Labor,
- Technology,
- Risk Capital, and
- Energy

It's quite apparent that economic growth is inextricably linked to energy. As energy is tied to our economy, our future is dependent upon equitable access to energy. This in turn sets the framework of our dependence on oil and hence, why our national security is tied to securing the flow of oil.

The production and use of energy are vital to the economies of all countries. The mix of energy sources has profound consequences for environmental quality. We need to realize that our dependence on oil could cripple our economy. Supply constraints or disruption to oil flow could derail economic activity. It should be an imperative for our national security to develop alternative energies.

The Government has formulated a new energy policy which envisages recommending an energy mix as a way forward where energy mix would mean regime change under which focus from thermal power will be shifted to cheaper energy production like bagasse-based

power generation. It also proposed phasing out subsidy on the power sector but also recommending subsidy protection for consumers using 300 or below units of electricity per month.

The country has many alternatives available which can be utilized to deal with the electricity shortfall. After analyzing different alternatives, we have come up with a conclusion that a multi-pronged strategy is required and several projects accompanied by strict scrutiny and administrative measures are the need of the day. Pakistan should strive to expand the use of renewable energy to help bridge the gap of energy deficiency in the country. The country is blessed with natural resources that can be utilized to create electricity.

Renewable resources that are technologically viable and have prospects to be exploited commercially in Pakistan include wind energy, solar energy, micro-hydel, bio-energy, and emerging technologies like fuel cell. Pakistan can benefit from these resources and can supplement existing energy resources as well as can use as primary energy source when no other option is available.

1.2 NON-CONVENTIONAL RENEWABLE ENERGY SOURCES

To meet the future energy demand and to give quality and pollution free supply to the growing and today's environment conscious population, the present world attention is to go in for natural, clean and non-conventional renewable energy sources. Which is also environmental friendly?

Further, it is an undisputed fact that the present level of generation of power from Hydel, Thermal and nuclear sources could not meet the increasing demand due to various problems. In order to reduce the Green House Gas Emission, the Non-Conventional Energy is to be utilized for the generation of electricity. One of the Non-Conventional renewable Energy source is Bagasse.

1.3 COGENERATION

Cogeneration is a system of commercially available technologies that decrease total fuel consumption and related GHG emissions by generating both electricity and useful heat from the same fuel input. Cogeneration is often called combined heat and power (CHP), since most cogeneration systems are used to supply electricity and useful heat. However, the heat energy from electricity production can also be used for cooling and other non-heating purposes, so the term "cogeneration" is more inclusive. Cogeneration is a form of local or

distributed generation as heat and power production take place at or near the point of consumption. For the same output of useful energy, cogeneration uses far less fuel than doe's traditional separate heat and power production, which means lower greenhouse gas (GHG) emissions as fossil fuel use is reduced.

Cogeneration offers other benefits that include:

- Reducing other air pollutants (e.g., SO_2, NO_X, Hg)
- Providing on-site electricity generation that is resilient in the face of grid outages thus providing power for critical services in emergencies and avoiding economic losses
- Avoiding or deferring investments in new electricity transmission and distribution infrastructure and relieving congestion constraints on existing infrastructure.
- Using existing industrial and commercial sites for incremental power generation rather than building new power plant capacity at Greenfield sites

1.4 POTENTIAL OF BAGASSE -FIRED POWER GENERATION IN PAKISTAN

Bagasse is the Crushed Residue of sugar cane. It is termed as a Captive Biomass that is fibrous in nature. It has a calorific value of 2250 kcal / kg. Bagasse is an excellent Raw Material for power generation. It provides a suitable and reliable source of steam and electricity to feed the sugar industry. Pakistan sugar industry that is one of the biggest industries in the region comprises 81 sugar mills with an annual capacity of about six million tons sugar. The industry crushes about 30 - 40 million tons of sugar cane that yields about 12 million tons of bagasse as an industrial waste that has a potential of generating 3000 MW electricity. Almost all 81 sugar mills have in-house bagasse based cogeneration power plants mostly to meet their own requirements. Only a few sugar mills have surplus electricity to sell to the power utility companies. The surplus power generated by the sugar industry can be synchronized with the National Grid or local grid.

Bagasse based cogeneration has the following advantages.

- Since the fuel (bagasse) is available virtually at no cost
- Fuel is available at site and the infrastructure for fuel transportation is not required
- Transmission losses are very less as the bagasse co-generation power plants is in the centre of Load.
- Net emission of carbon dioxide is very negligible.

- The sugar industry has decades of experience of related technology.
- It does not increase any foreign exchange outflow
- Bagasse based cogeneration provides employment to rural areas.
- Cogeneration reduces the Green House Gas emission. This will reduce the global warming.

Power Generation Process

Conventionally, the sugar mills use low pressure boilers (24 bara) for generating power and process steam. The steam passes through turbine and generates required power for the sugar plant. The exhaust steam from the turbine is used in the processing of sugar. This process of utilization of steam for generating power and for processing of sugar is called cogeneration. The proposed project will install High Pressure Boilers (115 bars) and steam Turbines. Using the same quantity of bagasse, the proposed power plant will be able to generate additional power for export besides meeting the power and steam requirement of the sugar mill. The additional power will be fed to the National Grid system.

1.5 PROJECT DESCRIPTION

The" National Policy for power co-generation by sugar industry "was notified in January 2006. This policy offers attractive incentive to the sugar mills as available to the IPPs under power policy in vogue. It includes guaranties for power purchase and payment, income tax, concessional duties on import of machinery, guaranteed rate of return on investment and etc. Amendments to the policy were made to favor the sponsors.

To respond to this policy, initiative was taken by the Digri-Gen Ltd., having their head office at 48-J/I, Block-6, PECH, Karachi-75400. Karachi. Pakistan is proposed to install co-generation power plant, using bagasse as fuel in one of the major sugarcane and sugar-producing district of Sindh, Pakistan. In project site sugarcane is being cultivated in large areas since many decades for manufacture of white refined sugar. Sugar industry is a major livelihood provider to millions of agricultural families and their dependents particularly in rural areas.

The plant is ideally located from the stand point of availability of bagasse (Fuel) from the adjacent sugar plant. The electricity produced will be sold to HESCO through 132 KV circuits.

The project will generate net 25MW electricity during the sugar production season and off season and 17.5MW and 21.50 MW respectively for export to the national electricity grid of Hyderabad Electric Supply Company (HESCO). Bagasse from Digri Sugar Mills will be used as fuel for approximately 168 days of the power plant operation. Total quantity of bagasse available for steam and power generation is around 255,000 tones. The proposed Project brings in multifold advantages. Not only does it produce clean, pollution free energy, it also has the capacity to provide employment to the people living in and around that area.

Company Goal

True success in individuals or in company requires more than just achieving economical goals. In a competitive global market, to be environmentally and socially responsible is challenging. Though challenging it is necessary especially in a growing economy like Pakistan. Hence, Digri-Gen Ltd. is organized and funded to be:

- Economically sustainable;
- Maintain high quality standards;
- Socially engaged in community and;
- Environmentally responsible.

1.6 NEED OF THE PROJECT

Pakistan has been facing substantial shortages in the power sector and the province of Sindh is no exception. The electricity shortfall in Sindh, including Hyderabad, has reached 800 megawatts and the citizens are bearing long hours of unscheduled and unpredictable load shedding with adverse social and economic consequences

The need to the power project is spelled out by the statement of the Chief Executive Officer of the HESCO who held the following as being mainly responsible for fluctuation and tripping in the power generation system:

- Old power supply system in project area
- Distribution losses.

Project Benefits

The major benefit of this project is that it would generate many facilities in the region such as communication, employment and transport. It will also benefit the district by the development of the rural area. The major share of the district income is from the agriculture sector. Agriculture resources can be used for conversion into value added products

Project Objectives

The project aims to produce electricity for supply to HESCO through national grid thus reducing the supply and demand imbalance. The proposed power plant is a standalone power producing unit based on Bagasse fired Boilers along:

- Respond to the urgent need to close the widening gap between power generation and demand at Digri, District Mirpurkhas, Sindh.
- Ensure stable power supply to HESCO
- Provide employment to the local people;
- Respond to the need of improvement in quality of life through sustainable power production systems.

Social Infrastructure

Further improvements in infrastructural facilities ultimately result in development of area which will automatically enhance the social status of the area as well as native's standard of livings. Ancillary business establishments will be helpful for further growth in market, trading and business centers leading to regional development. Interaction & understanding between different souls, families, communities, societies, regions, culture, traditions, social traits etc. beneficial for reducing differences leads towards unity & prosperity

The Need for Environmental Assessment

Economic, social and environmental change is inherent to development. While development aims to bring about positive change it can lead to conflicts. The promotion of economic growth as the motto for increased well being was the main development thrust with little sensitivity to adverse social or environmental impacts. The need to avoid adverse impacts and to ensure long term benefits led to the concept of sustainability. This is accepted as an essential feature of development if the aim of increased well being and greater equity in fulfilling basic needs is to be met for existing and future generations. In order to predict environmental impacts of any development activity, to provide an opportunity to mitigate against negative impacts and enhance positive impacts, environmental impact assessment is carried out.

Pakistan's efforts to protect the environment by using Environmental Impact Assessment in project planning can be said to be based on the Penal Code of 1860 which considered fouling of water and air as punishable offences. Promulgation of an Ordinance in 1983 followed by the Pakistan Environmental Protection Act, 1997 and Sindh Environmental Protection Act

2014 provides the Initial Environmental Examination (IEE), and Environmental Impact Assessment (EIA) a legal requirement. According to clause 17(I) part-vi dealing Environmental Examinations and Assessments of Sindh Environmental Protection Act 2014:

"No proponent of a project shall commence construction or operation unless he has filed with the Agency an initial environmental examination or environmental impact assessment, and has obtained from the Agency approval in respect thereof"

1.7 SCOPE OF IEE STUDY

The purpose of this IEE study is identification of key environmental and social issues which will likely arise during construction and operation of the power plant along with the assessment of the significant negative impacts and mitigation measures to be adopted for their minimization.

The ultimate goal of this IEE report is to produce an Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMP) for the Construction and Operation Stages of the proposed project. Compliance with the guidance contained in these plans will ensure the implementation of this project in an environmentally sustainable manner both at Construction as well as Operation stages of the Project.

The IEE report ensures compliance to all national and local regulations enforced in Pakistan. This IEE_report is developed in a manner that it is socially responsible and reflects sound environmental management practices.

This IEE report also discusses the legal and administrative framework within which the IEE is prepared. A brief project description is included together with a description of the baseline environmental conditions and the actual environmental situation at the proposed site for the project.

The technical section of the report and the environmental baseline situation form the basis for the detailed impact assessment during the construction and operation phases of the project. Based on the findings of this report, an environmental management system has been devised, outlining necessary mitigation and compensation measures together with monitoring practices.

1.8 OBJECTIVE OF THE IEE STUDY

The objective of Initial Environmental Examination (IEE) is to prepare a document based on anticipated Environmental Impact due to setting up of bagasse based cogeneration Power Project and to applicable provincial and SEPA regulations.

Approach and Methodology

This IEE report regarding the Bagasse Based Cogeneration Digri-Gen Ltd., District Mirpurkhas, Sindh; Pakistan) has been accomplished after carrying out thorough reconnaissance to identify the following Environmental and Social areas of concern:

- To achieve the desired environmental compliance standards under the Sindh Environmental Protection Act 2014 Guidelines as applicable to the project.
- Plans and activities to remedy/mitigate any potential adverse impacts and the gaps that could probably remain after implementation
- Any other points/steps to be taken which could be beneficial to mitigate environmental adverse impacts that may accrue both during construction and regular operation of the power plant.

In addition to the evaluation and review of the available records, data and the facts for the project feasibility study, detailed discussions were held with the concerned members of the project management.

Notes and proposals for measures to be taken to mitigate and compensate for any determined/detrimental environmental impacts are contained in the Environmental Management Plan (EMP) as well as a Monitoring Plan, including all parameters that need to be measured, and the frequency of monitoring actions.

A comprehensive qualitative and semi-quantitative methodology was adopted to conduct this study inter-alia in due compliance with the IEE requirements. The study included collection of both primary and secondary data regarding environmental status and other relevant factors.

Reporting

In the end, all activities / steps performed during IEE study were documented in shape of IEE report; it was compiled in the format / guideline given by Pakistan Environmental Protection Agency (PEPA) in Pakistan Environmental Assessment Procedures, 1997.

1.9 CONTENTS OF THE REPORT

The report has been divided into eight chapters and presented as follows:

Chapter 1: Introduction

Chapter one provides purpose of the report, background information of the expansion project, brief description of nature, size and location of project, and scope of the study.

Chapter 2: Legislative Requirements

The key environmental legislation and the standard relevant to the project and the methodology adopted in preparation of the report have also been described in this chapter.

Chapter 3: Environmental Status of the project Area

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

Chapter 4: Technical Details & Design of Cogeneration Power

Chapter four deals with the location, process, other technical and design information highlights a few of the technical issues for designing of the co-generation projects.

Chapter 5: Analysis of Alternatives

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

Chapter 6: Anticipated Environmental Impacts and Mitigation Measures

This chapter deals with the details and the inferences drew from the anticipated Environmental Impacts of the project during various stages of project advancement, such as design, location of project, construction and regular operations. The chapter also provides recommendations/Environmental Management Plan (EMP) including mitigation measures for minimizing the negative environmental impacts of the project and enhancing the positive impacts.

Chapter 7: Environmental Management Plan

This chapter describes the institutional arrangements for environment protection and Conservation during the operational stage of the Project and the management strategy for the project. Environmental monitoring requirements for effective implementation of mitigatory measures during expansion and operational phase have been also delineated in this chapter.

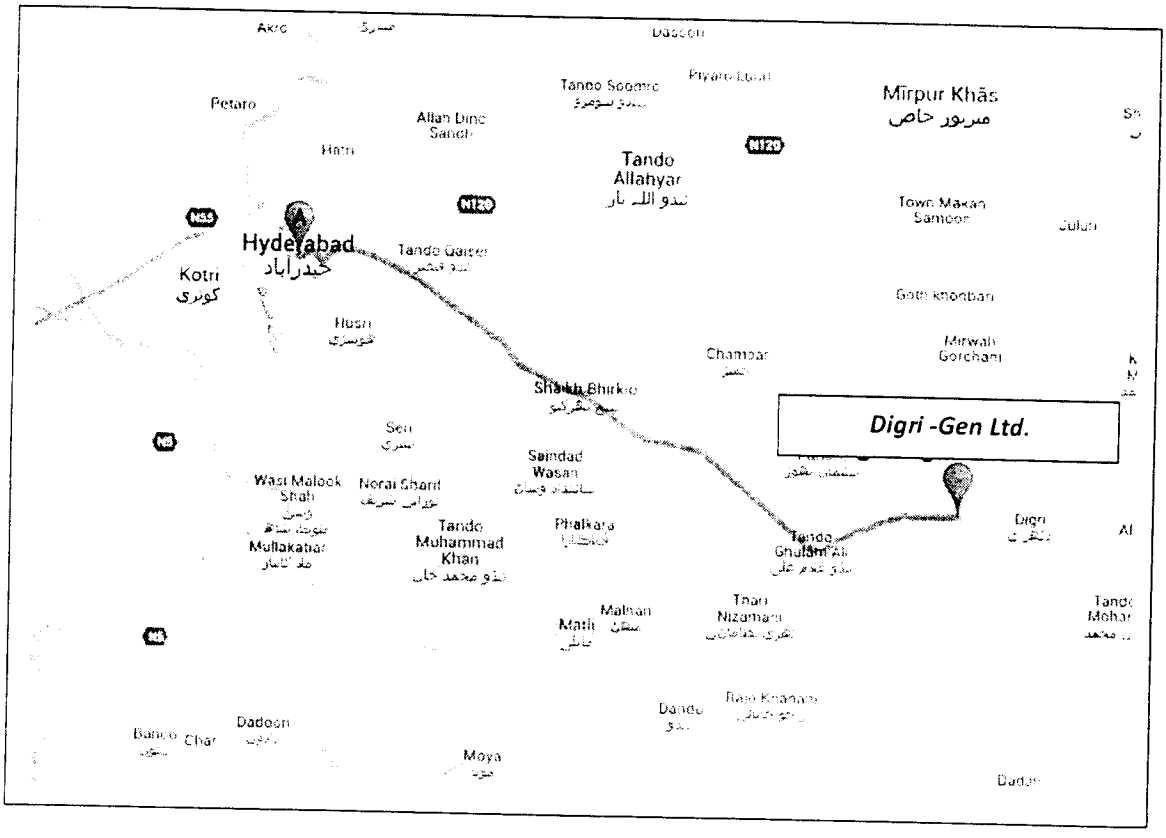
Chapter 8: Conclusion & Recommendations

The summary of the IEE report has been given in this chapter along with conclusions and recommendations

Salient Features of the Project Site

Feature	Particular
Project Name	Digri-Gen Ltd
Head Office	48 -J/1, Block - 6, P.E.C.H, Karachi. Tel. # 021-34541195, 021- 34541198 Fax # o21-34534501
Location	Deh 153, Taluka Digri, District Mirpurkhas, Sindh. digri@cyber.net.pk Tel # 0233-869200 Cell # 0300-3314346
Installation Capacity	2.5 MW
Net generation output	22.5MW
Latitude / Longitude	25.15'11° North latitude, 69.11'19°East longitude
Temperature in °C	Maximum and minimum temperatures of 45° and 21°C respectively
Average Relative Humidity	54%
annual Rainfall	26.84mm (max)
Average Wind Velocity	19.2mph
Soil Profile	Clay, silty clay loam, and loam and clay loam textures.
Sensitive locations like protected forests, monuments, national park, zoos etc	No sensitive location within 10 km radius

LOCATION MAP OF DIGRI-GEN LTD.



LEGISLATIVE REQUIREMENTS

2.1 GENERAL

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

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

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

2.2 NATIONAL ENVIRONMENTAL POLICY AND GUIDELINES

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

National Conservation Strategy (NCS)

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

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

National Environmental Policy

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

incentives for efficient products. It also calls for creating increased public demand for environmentally friendly products through education and mass awareness campaigns.

National Sanitation Policy

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

2.3 ENVIRONMENTAL INSTITUTIONAL FRAMEWORK

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

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

2.4 ENVIRONMENTAL GUIDELINES

A. The Sindh Environmental Assessment EIA/ IEE Procedures 2014

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

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

B. National Environmental Quality Standards (NEQS)

Government of Pakistan in early 1990s realized the importance of environmental pollution control by introducing National Environmental Quality Standards (NEQS) through statutory notifications as per recommendations of various advisory committees. Pakistan Environmental Protection Committee (PEPC) in its first meeting held on 10th May 1993 approved the NEQS. Later on, a set of NEQS was announced under SRO 742 (1) 93 dated 24th Aug 1993. These approved 32 parameters prescribing permissible levels of pollutants in liquid effluent while 16 parameters for gaseous emission were of uniform standards applicable to all kinds of industrial and municipal effluent. Revised NEQS were approved by the Council in December 28, 1999. These NEQS were made effective under SRO 549 (1) 2000 dated 8th August 2000.

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

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

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

Self-Monitoring and Reporting

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

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

2.5 NATIONAL ENVIRONMENTAL LEGISLATIONS

Pakistan Environmental Protection Act 1997

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

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

legislation and they have been given the power to conduct inquiries into possible breaches of environmental laws either of their own accord, or upon the registration of a complaint.

2.6 SINDH ENVIRONMENT PROTECTION ACT 2014

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

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

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

Pakistan EPA Review of IEE and EIA Regulations- 2000

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

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

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

- The IEE / EIA must be prepared, to the extent practicable, in accordance with the Pak-EPA environmental Guidelines discussed in the sections to follow.
- A fee, depending on the cost of the project has been imposed for review of the IEE and EIA.
- The submitted report is to be accompanied by an application in prescribed format included as Schedule - IV of the Regulation.
- The EPA is bound to conduct a scrutiny and reply within 10-days of submittal of report (a) confirming completeness (b) asking for additional information, or (c) requiring additional studies.
- The EPA is required to make every effort to complete the review process for the IEE within 45-days, and of the EIA within 90-days, of issue of confirmation of completeness.

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

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

2.7 THE SINDH EPA REVIEW OF IEE AND EIA REGULATIONS 2014

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

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

Other Relevant Laws

National Resettlement Policy and Ordinance

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

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

Land Acquisition Act, 1894

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

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

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

(1) Based on the LAA, only legal owners and tenants registered with the Land Revenue Department or possessing formal lease agreements are eligible for compensation or livelihood support.

(2) It is also noted that the LAA does not automatically mandate for specific rehabilitation / assistance provisions benefiting the poor, vulnerable groups, or severely affected PAPs, nor it automatically provides for rehabilitation of income/livelihood losses or resettlement costs. This however it is often done in many projects in form of ad hoc arrangements based on negotiations between a specific Environmental Approval (EA) and the PAPs.

(3) Exceptions to the rule are intrinsic to the fact that the law is elastic and are broadly interpreted at provincial level depending on operational requirements, local needs, and socio-economic circumstances. Recourse is often taken to ad hoc arrangements, agreements and understandings for resettlement in difficult situations. The above is also influenced by the fact that an amendment of the LAA has been considered necessary by the Ministry of Environment. Accordingly, a National Resettlement Policy (NRP) and a Resettlement Ordinance have been drafted to broaden LAA provisions and current practices so as to widen the scope of eligibility and tightening up loopholes (i.e. regarding definitions of malpractices, cut-off dates, political influence on routing, etc.). But both these documents are still awaiting government's approval for implementation.

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

Affected Person Ordinance 2001

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

Biodiversity Action Plan

The key to protection of the biological heritage of Pakistan lies in the involvement of local people and in the support provided by competent institutions for conservation and

sustainable use. The Government of Pakistan has recognized the importance of these measures in the preparation of the National Conservation Strategy and in becoming a signatory to, and ratifying, the Convention on Biological Diversity (CBD) in 1994. Developing the Biodiversity Action Plan for Pakistan, 2000 has been the most significant direct steps towards addressing the biodiversity loss.

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

Canal and Drainage Act, 1873

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

The Sindh Irrigation Act 1879

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

Employment of child Act, 1991

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

cement manufacturing, textile, construction and others. SSGCL and its contractors will be bound by the ECA to disallow any child labor at the Project sites or campsites.

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

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

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

Sindh Wildlife Protection Ordinance, 1972

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

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

Antiquities Act, 1975

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

The Sindh Cultural Heritage (Preservation) Act, 1994

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

Among various provisions of this act some are, formation of an Advisory Committee to government to overlook and subsequent right of Acquisition of a protected heritage of

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

Sindh Local Government Ordinances, 2001

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

Forest Act, 1927

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

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

National Forest Policy, 2001

The National Forest Policy deals with the Renewable Natural Resources (RNR) of Pakistan such as forests, watersheds, rangelands, wildlife, biodiversity and their habitats with the aim

to eliminate the causes of depletion to such resources through the active participation of various concerned stakeholders and government departments.

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

2.8 NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA) ACT 1997

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

Power Policy 1998

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

- The basis for selection of private power project will be minimum level-zed tariff through International Competitive Bidding. Variable tariffs over the life of the project will be permitted under terms specified prior to bidding. The process of selection will involve pre-qualification, issuance of a Request for Reports (RFP), bidding and evaluation of bids against bid criteria clearly laid out in the RFP.

- It is recognized that without a proper feasibility study for a particular site specific hydel or indigenous coal based project, it will not be possible to invite competitive bids and receive firm offers. Thus, detailed feasibility studies for such projects will be prepared before bids are invited.
- Hydel projects will be implemented on a Build Own Operate Transfer (BOOT) basis; to be transferred to the province in which it is situated at the end of the concession period, and thermal projects on a Build Own Operate (BOO) basis.
- Competitive Tariffs will comprise an Energy Purchase price and a Capacity Purchase Price with adequate provisions for escalation.

2.9 INTERNATIONAL GUIDELINES AND TREATIES/CONVENTIONS

World Bank Guidelines on Environment

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

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

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

International Convention on Biodiversity

The International Convention on biodiversity was adopted during the Earth Summit of 1992 at Rio de Janeiro. The Convention requires parties to develop national plans for the

conservation and sustainable use of biodiversity and to integrate these plans into national development programs and policies. Parties are also required to identify components of biodiversity that are important for conservation, and to develop systems to monitor the use of such components with a view to promoting their sustainable use.

Environment Related Relevant International Agreements in Pakistan's context

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

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

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

Applicable International Environmental and Occupational Safety and Health Laws and Regulations

International and National Non-Governmental Organizations

International and National Non-Government Organizations (NGOs), such as the International Union for Conservation of Nature and Natural Resources (IUCN) and the World Wide Fund for Nature (WWF), have been active in Pakistan for some time. Both of these NGOs have worked closely with the Governments at the Federal as well as Provincial levels and have positively contributed to the cause of environment. They have played significant role with regard to the formulation of environmental and conservation policies. And last but not the least, another the most prominent NGO namely "Sustainable

Development Policy Institute" (SDPI) has also played very significant role in upholding the cause of environmental protection in Pakistan. Environmental NGOs have been particularly active in the advocacy for promoting sustainable development approaches. Most of the government's environmental and conservation policies, even at the provincial and federal levels, have been formulated in consultation with these leading NGOs, who have also been involved in drafting new legislation on conservation.

ENVIRONMENTAL STATUS OF THE PROJECT AREA

3.1 PREFACE

This chapter provides information on the physical, biological and socio-economic elements of the environment, which shall be used as benchmarks for future monitoring. The area considered for assessment of baseline conditions span the whole project vicinity which will be large enough in extent to include all potential impacts from the project.

The baseline status of environmental quality in the vicinity of project site serves as the basis for identification, prediction and evaluation of impacts. The baseline environmental quality is assessed through field studies within the impact zone for various components of the environment, viz. air, noise, water, and land and socioeconomic.

Knowledge of baseline environmental status of the study area is useful for Impact Assessment Process of assessing and predicting the environmental consequences of the significant actions. Significant action depicts direct adverse changes caused by the action and its effect on the health of the biota including flora, fauna and human being, socioeconomic conditions, current use of land and resources, physical and cultural heritage properties and biophysical surroundings. Baseline data generation of the following environmental attributes is essential:

- Meteorology
- Ambient Air Quality
- Ambient Noise Quality
- Surface and Ground water Quality
- Soil Quality & Geological Features
- Land use pattern
- Biological Information
- Socio-economic status survey

3.2 ESTABLISHMENT OF IMPACT ZONE

Deciding whether a proposed action is likely to cause significant adverse environmental effects is central to the concept and practice of EIA. Before proceeding for baseline data

generation, it is important to know the boundary limits and framework, so that the data generated can be effectively utilized for impact assessment.

In this context, delineate of impact zone plays an important role. Generally the impact zone for industrial actions is classified into three parts; Core Zone, buffer Zone and Unaffected Zone, as illustrated below. The area of impact zone invariably changes from project to project and depends on the nature and magnitude of activities.

Core Zone (Host and Proximate Area where the proposed activities are completed)
This area is closest to the activity where the background quality of environmental and human health is always at high risk. This involves risks due to steady state, transient and accidental release of pollutants, noise, increased traffic congestion and social stress. The immediate vicinity of the plant that is around 3 km radius is factual core zone in this case.

Buffer zone (Moderately affected area)
Being a little away from the activity, the discharge pollutant need time lag to be transported to this area and gets attenuated/diluted to a considerable extent. However, the associated risk shall be real during brake down, failure or upset conditions, and simultaneously with adverse meteorological and hydrological factors. Distance from 3 km to 7 km around the project site in the factual buffer zone in this case. This is based on the mathematical modeling study and air pollution dispersion pattern.

Unaffected Zone
This area shall not be at risk of serious damage to life, health and property. Here the impact becomes small enough to become imperceptible and/or inconsequent and/or insignificant and nor0mal life activities shall prevail without any disturbances due to the activity. Distance away from the 7 km buffer zone is the factually unaffected zone in this case.

While generating the baseline status of physical and biological environment of the study area, the concept of impact zone has been considered. The Impact zone selection is based on preliminary screening and modeling studies. For demography and socio-economics, block wise data has been collected and used for the assessment of impacts.

Specific Objective
By implementing an Environmental Management Plan (EMP) in accordance with the SEPA Standards, the objectives include:

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

Secondary Objectives

- Reducing environmental liability and risk,
- Helping to maintain consistent compliance with legislative and regulatory requirements,
- Preventing pollution and reducing waste,
- Pollution-incident coverage is issued,
- Identifying areas for reduction in energy and other resource consumption,
- And demonstrating commitment to high quality.

3.3 METHODOLOGY OF ENVIRONMENTAL BASELINE SURVEY

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

Site Visits/ Survey

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

Scope

Consultation with clients

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

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

Baseline Data Generation

List of important physical environmental components and indicators of EBM are given in Table 3.1:

ENVIRONMENTAL COMPONENT	ENVIRONMENTAL INDICATORS
Climatic variables	• Rainfall patterns - mean, mode, seasonality • Temperature patterns Extreme events • Climate change projections • Prevailing wind - direction, speed, anomalies • Relative humidity • Stability conditions and mixing height, *etc*
Topography	• Slope form • Landform and terrain analysis • Specific landform types, *etc.*
Drainage	• Surface hydrology • Natural drainage pattern and network • Rainfall run off relationships • Hydrogeology • Groundwater characteristics - springs, *etc.*
Soil	• Type and characteristics • Porosity and permeability • Sub-soil permeability • Run-off rate • Infiltration capacity • Effective depth (inches/centimeters) • Inherent fertility • Suitability for method of sewage disposal, *etc.*
Geology	• Underlying rock type, texture • Surgical material • Geologic structures (faults, shear zones, *etc.*)

	• Geologic resources (minerals, *etc.*)
Water	• Raw water availability • Water quality • Surface water (rivers, lakes, ponds, gullies) - quality, water depths, flooding areas, *etc.* • Ground water - water table, local aquifer storage capacity, specific yield, specific retention, water level depths and fluctuations, *etc.* • Coastal • Floodplains • Wastewater discharges • Waste discharges, *etc.*
Air	• Ambient, Respirable, Air shed importance • Odor levels, *etc.*
Noise	• Identifying sources of noise • Noise due to traffic/transportation of vehicles • Noise due to heavy equipment operations

3.4 GEOGRAPHICAL CHARACTERISTICS

Mirpurkhas District

The district Mirpurkhas is situated at the south east corner of the province. It lies from 25° 0' to 29° 17' North latitude and 69° 3` to 69° 26` east longitude. It is bounded on the north by the district of sanghar in the east by the newly created district Umerkot bordering the Bermet/Marwar and Jaisalmir district of India. . It is bounded on the West by Tando Allah Yar and Hyderabad districts, on the South by Badin and Tharparkar districts.

Climate

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

January and February are the coldest months. The mean maximum and minimum temperature during the period are 28°C and 9° C respectively.

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

Table 3.2: Overview of Climate

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

Humidity

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

Rainfall

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

3.5 PHYSICAL ENVIRONMENT

Topography

Almost all the barrage (irrigated) area falls in the district Mirpurkhas which is conducive to Agriculture Cultivation and happen to be more densely populated with 108 persons per

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

Demographic characteristics

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

Geology

The deposits contain small sized rounded pebbles of sandstone, quartzite or granite and sand mixed or alternating with clayey deposits. They have been described as alluvial deposits, but it is equally probable that they have a glacial origin. The soil of the project area is silt clay and highly fertile land of high productivity especially in the barrage area of district Mirpurkhas.

Soil

Particle size distributions show that most of the soil profiles had layers with clay, silty clay loam, and loam and clay loam textures. The main reasons for this particle size distribution pattern in the study area was possibly due to the nature of the parent material, the eluviations, alleviation and also may be some faunal activities It is evident that the soils of

lower Indus Plain contain more clay. Similar soil texture trend is also observed in salt-affected soils of Hyderabad district, the area adjacent to Badin district.

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

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

Although, the concentrations of Na^+ and Cl^- remained high in top layers, both Na^+ and Cl^- followed by SO_4^{2-} and HCO_3^- were found to be the dominant ions in almost all layers. Carbonates (CO_3^{2-}) generally remained absent in almost all soil samples, except only in those soil samples taken from bottom layers of Profile 2. The distribution of HCO_3 generally remained uneven and irregular throughout the soil profiles.

Land Utilization

The pattern of land use in a region determines crop production. Soil & climate play an important role in the management of cropping pattern of a region. Crop area used for food and cash crops can be taken as an index of the type of land system and the economic use for these crops. Land use data for latest five years are given in table No.1. The reported area in Mirpurkhas remained unchanged since in 1993-94 and recorded at 299.1 thousand hectares in 1997-98. However, not all of this area is cultivable. 32.1% was reported as "uncultivable" though its share was 31.0% in 1993-94.

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

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

Surface Water

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

Ground Water

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

Water Supply and Drainage

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

Urban Drainage

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

Rural Water Supply

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

Rural Drainage

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

Agriculture Sector

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

The economic development of Sindh is largely dependent on the progress and growth of Agriculture sector. Sindh province contributes significantly towards over all national agriculture with 26% of the cultivated area, 17% of the cropped area and 16% of the irrigated

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

Agriculture Sector

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

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

Live Stock

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

income by selling products. Production for market even at the expense of consumption at home has become quite common in many areas of Sindh. There are pockets of organized live stock farming such as cattle farms (or colonies) and poultry farms, located mainly in the urban areas. Most other units are of small size and not well kept.

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

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

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

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

Inland Fisheries

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

Inland fish production has been increasing over the years. In Mirpurkhas district, the inland fish production registered an increase of 50.0% to in 1997 over the preceding year. It is

reported that Mirpurkhas district contributes very negligible share of 0.01% on the total 91903 metric tons inland fish production of Sindh.

Forest

Forests are not only necessary for habitation of livestock population but also instrumental in improving environmental quality and dependable source for meeting domestic energy requirements of fuel wood. Besides it helps in conservation of soils, improve environment by controlling pollution, cause rainfall and climatic changes supplement source of energy and stabilize gas and oil prices. The forestry program in Sindh envisages management of forest on commercial basis in the Riverine forests, irrigation plantation forests, and mangrove forests, development of Social Forestry, Agriculture, Coconut and Range lands.

Total forest area in Sindh is 1161 thousand hectares or 8.3% of the Sindh province area which is far below the desired ratio of 20 to 30 percent considered necessary for balanced ecology. The per capita forest area being 0.039 hectare in Sindh province or 0.032 hectares in the country was also quite low as compound to the world average of about 1.0 hectare. In Mirpurkhas District, the forest area is spread over 1.2 thousand hectares which is 0.1% of the total area under forest in Sindh in the year 1997-98.

Air Quality

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

Noise and Vibration

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

3.6 BIOLOGICAL ENVIRONMENT

Flora

The type of soil i.e. sandy, loamy, water logged or saline, and the amount of moisture available mainly governs the vegetation species. Mostly, both sides of the road are covered with thick vegetation that full fills its water requirements from the seepage water of farmlands, agricultural fields and canals of irrigation water network. In the water logged areas between Jamrao Bridge and Mirpurkhas, where Tamarix aphylla is the dominant Species which is followed by Haloxylon stocksii as the second dominant species of saline areas,of commercial value. The dominant trees in Mirpurkhas district is babul (Populus euphrafica), ber (Zizypuhs numularia) and several verities of Tamarix like plai (Tamarix gallica) and jhao (Tamarix diocia), talhi (Dalbergia sisoo), kri (Tamarix gallica), karir (Copparis aphylla). Number of ornamental flowers found in farms, gardens and elsewhere in the area are rose (Rosa damascena), jasmine (Jasminum officinale), and tuberose (Polianthes tuberose) etc. The area is mostly covered with weeds like Tamarix aphylla and Salvadorapersica and exotic species like Prosopis glandulosa.. Old plantations of Azadirachta indica (Neem), Albizia lebbek (Shrin), Ficus religiosa (Peepal), Acacia nilotica (Babul), Cordia myxa (Lasura) and Ficus benghalensis (Borh) have special importance. Following Floral species were observed which are dominant in the area.

Table 3.3: **Number of Species Belonging To Dominant Families**

No	Family Name
1	Poaceae
2	Asteraceae
3	Mimosaceae
4	Papilionaceae
5	Cyperaceae
6	Malvaceae
7	Moraceae
8	Solanaceae

The data on medicinal plants in the vegetation of district Mirpurkhas, Sindh was recorded during the month of June 2012. Thirty four families, 51 genera and 53 species were recorded which are used by local inhabitants as a medicine, fodder, fuel and for agricultural purpose

Important commercial crops of the project area are Saccharum officinale (Sugar cane), Brassica oleracea (Cabbage), Capsicum annum (Chilli), Gossypium sp. (Kapaas), Oryza sativa (Dhaan), Sorghum vulgare (Jawar) and Hibiscus esculentus (Bhindi). Similarly, fruit

orchards comprising of Chiku, Mangoes of various varieties including Chounsa, Sindhri, Dosehri, Langrha, Fajri, Almas, Malda saroli and Tota parri. Jaman and Ber trees are also commonly cultivated along boundaries of fruit orchards.

Table 3.4: Life Form-Wise Breakdown of Species

No	Life Form
1	Herbs
2	Shrubs
3	Grasses
4	Trees
5	Climbers
6	Sedges
7	Creepers

Fauna

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

3.7 ENVIRONMENTAL CONCERNS

In general, combustion of standard fossil fuels in commercial and industrial boilers results in the following emissions, CO_2, N_2, O_2, H_2O, CO, NOx, SO_2, volatile organic compounds, and particulate matter. The latter five products of combustion are considered pollutants and are known to, either directly or indirectly, cause harmful effects on humans and the environment. In case of bagasse-fired boilers, the pollutants emitted are CO_2, CO, TSP, SOx, and NOx of which the latter two products are emitted in small amount [16]. Emissions of SO_2 and NOx are lower than conventional fossil fuels due to the characteristically low levels of sulfur and nitrogen associated with bagasse. However, if auxiliary fuels are used during startup of the boiler or when the moisture content of the bagasse is too high to support combustion, then SO_2 and NOx emissions will increase].

Social Concerns

The energy and environmental implications of ethanol production are more important than ever. Much of the analysis and public debate about ethanol has focused on the sign of the net energy of ethanol: whether manufacturing ethanol takes more nonrenewable energy

than the resulting fuel provides. It has long been recognized that calculations of net energy are highly sensitive to assumptions about both system boundaries and key parameter values. In addition, net energy calculations ignore vast differences between different types of fossil energy. Moreover, net energy ratios are extremely sensitive to specification and assumptions and can produce un-interpretable values in some important cases.

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

3.8 PROJECT BENEFITS

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

Improvements in the Social Infrastructure

It will not disturb the existing pattern of social relations and democratic set up. The Proponents are already in this area running their sugar unit over the years. The sugar unit is not only running with efficiency it is running with no disturbance from the local people. Local people have even encouraged the expansion at this same site of sugar production. The same is the case for diversification for alcohol. This is mainly because the Proponent is accepted by local culture, without any disturbance to the existing pattern of social relations or hierarchy. Time management is of importance especially in industrialized community though may not be so in agriculture oriented society. In rural background much of the time and energy is wasted in reaching from one place to another. This is due to lack of swift mode of transport. By the presence of this industry, number of vehicles in this area is generally

improved (both private and public-owned). This is helping in shortening the time reaching destination and utilize it for some fruitful is productive work.

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

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

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

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

Employment Potential - Skilled, Semi-Skilled and Unskilled

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

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

Improvements in the Physical Infrastructure

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

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

Greening drive in the premises gives a pleasant look to the land. It absorbs some portion of the CO_2 produced by fuel burning (utilities) as well as created by fermentation (process). For greening fresh water is not used. The treated wastewater will be recycled and its CNPK contents are useful as nutrients. Canopy of trees arrests dust fugitive SPM as well as the noise.

3.9 CONCLUSION

1. The land use assessment shows that increasing productivity of sugarcane and farming will reduce land use impact resulting in the long-term sustainability of bio-fuel feed-stocks. One of measures to increase feedstock productivity is to improve soil quality by using organic fertilizers or animal waste to reduce chemical fertilizers consumption. Manure application is valuable for improving soil physical, chemical and biological properties resulting in improved water infiltration reduced runoff and reduced erosion.
2. Reduction of air emissions from agricultural activities, especially, preventing the sugarcane trash burning during harvesting could help decreasing CH_4, CO and NO_x emissions which contribute to global warming, photochemical oxidation, acidic-fixation, etc.

3. Enhancing waste management efficiency of bagasse producers and creating value-added or credits to the environment by promoting waste recycling such as biogas recovery, organic fertilizer production and Dry Distillers Grains (DDG) or Dry Distillers Grains with Soluble (DDGS) production.

Progress toward attaining these goals will require new technologies, practices as well as the transparent enthusiastic implementation from top to bottom. Such an approach could lead to a bio fuels industry that in conjunction with greater vehicle efficiency, play a key role in meeting the nation's energy and environmental goals.

TECHNICAL DETAILS AND DESIGN OF COGENERATION POWER PLANT

4.1 TECHNICAL ASPECTS

Co-generation based on Rankine Cycle is not new to the sugar industry, however Co-generation based on high pressure boilers and extraction condensing or straight condensing machines are definitely new to the industry. In olden days, the power cycle adopted was bases on 14 kg/cm2 (g) and 21 kg/cm2 (g). This has been gradually increasing to 32 kg/cm2, (g), 45 kg/cm2, (g), 66 kg/cm2, (g), 86 kg/cm2, (g), 110 kg/cm2, (g) and now stabilized at 124 kg/cm2 (g) and 540°C. With the size of the co-generation plant going above 40MW the use of 135 kg/cm2 (g) pressure cycles are being explored. The following highlights a few of the technical issues for designing of the co-generation projects.

4.2 THE BASIC DESIGN OF THE CO-GENERATION PLANT

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

Even though there is no limit to the achievable steam pressure and temperatures with bagasse firing, it is essential a cost benefit study is made before deciding on the steam cycle parameters. In such a study proper consideration should be given to the cost aspect of the higher grade metallurgy of the turbine and the boiler, specifically the super-heater and the piping. When the industry is working in full strength its co-generation efficiency ranges from 84% to 92%.

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

Topping Cycle

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

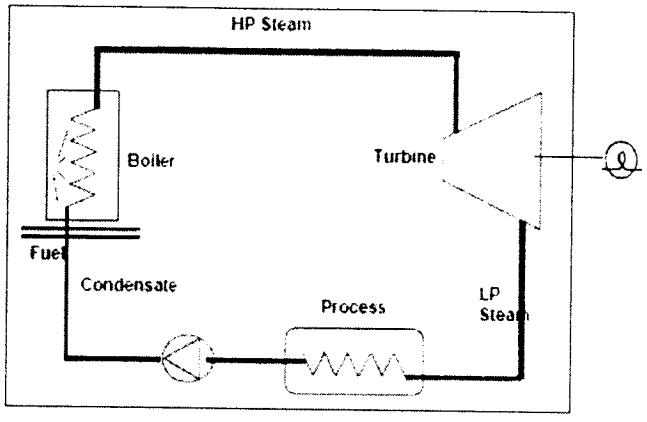


Fig 4.1: Back-pressure steam turbine system

4.3 TECHNOLOGY DESCRIPTION

Basic Process

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

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

Components

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

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

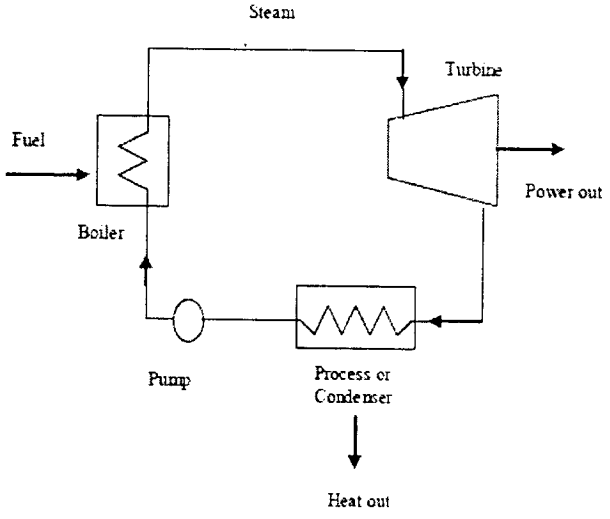


Fig 4.2: Boiler / Steam Turbine System

Table 4.1: PMEL Plant Description

(i)	Plant size installed capacity	25 MW Gross
(ii)	Type of Technology	Cogeneration Plant with high pressure boiler of 110 bar, 540 C class; turbo-generator with extraction steam and condenser, cooling towers and balance of plant
(iii)	Number of Units/Size (MW)	1 x 25MW
(iv)	Fuel	Bagasse except for start up
(iv)	Unit Make/ Model & Year of Manufacture	New boiler, turbo generator, switch gear and BOP
(v)	Commissioning/Commercial Operation date of each Unit of the Generation Facility	Within 20 months from financial Close
(vi)	Expected Useful Life of the each Unit of the eneration Facility from its Commercial	30 years

	Operation/ Commissioning Date	
(vii)	Expected Remaining useful Life of each Unit of the Generation Facility (at the time of grant of (Generation License)	30 years
(viii)	Generation Voltage	11,000 Volts
(ix)	Frequency	50 Hz
(x)	Power Factor	0.8
(xi)	Automatic Generation Control (AGC)	Yes
(xii)	Ramping Rate	3.2 Kw/sec
(xiii)	Time required to Synchronize to Grid	4 hours for cold start

Table 4.2: Technical Details of Proposed Co-Generation Power Plant

Description	Season	Off- Season
Days	120	60
Gross Capacity (MW)	25	25
Auxiliary Consumption (MW)	2.5	2.5
Net Installed capacity (MW)	22.5	22.5
Sugar Mills Consumption (MW)	5.0	1.0
Exportable Capacity to Grid	17.5	21.5
Total Bagasse Generated (MT)	840,000	-------
Total Bagasse Consumed (MT)	560,000	280,000

Table 4.3: Fuel Raw Material Details

(i)	Primary Fuel	Bagasse	
(ii)	Alternate / Backup Fuel	Furnace Oil	
(iii)	Fuel Source (Imported / Indigenous)	Primary Fuel	Alternate / Back-up Fuel
		Bagasse	Furnace Oil
(iv)	Fuel Supplier	From Sugar Mills	From Any oil Supplier
	Supply Arrangement	Primary Fuel	Alternate/ Back- Up Fuel

		Through Conveyor Belts/	Through Loading Tankers and Pumping
(v)	Sugarcane Crushing Capacity	7,000 TCD	
(vi)	Bagasse Generation Capacity	2100 Ton/Day	
(vii)	Fuel Storage facilities	Primary Fuel	Alternate/ Back- Up Fuel
		Within Premises Yard	Near Boiler
(viii)	Capacity of Storage Facilities	Primary Fuel	Alternate/ Back- Up Fuel
		120,000 Ton	Tank -1 / Tank -2 / Tank -3 / Tank -4
			75 ton / x / x / x
(ix)	Gross Storage Capacity	Primary Fuel	Alternate / Backup Fuel
		125,000 Ton	x

Table 4.4: Emission Values

		Primary Fuel	Start up Fuel
(i)	SOx (mg/Nm3) as SO2	<1700	--
(ii)	NOx (mg/Nm3)	<400	<600
(iii)	CO_2	12-16	--
(iv)	CO (mg/Nm3)	<800	--
(v)	PM10(mg/Nm3)	<500	<300

Table 4.5: Cooling System

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

ANALYSIS OF ALTERNATIVES

5.1 INTRODUCTION

A project of any nature consists of various activities, which involve men, money and material. These activities may consume natural resources and discharge wastes, which are likely to have serious consequence to the environment. A number of alternative options may be available to carry out many of these activities. An option with least or nil adverse environment impacts is to be selected. Critical analysis is therefore required for selection of the right alternative. Alternative Analysis (AA) has been done for critical aspects of the project. The project will be using ample availability of sugarcane from command area & bagasse (renewable energy source) from nearby sugar unit for generation of power i.e. 17.5MW and 21.5MW (net) during crushing season and during off season respectively to supply much needed power to national grid. Displacement of fossil fuel energy production during bagasse use period will also result in net reduction in CO_2 emissions so contributing to the control of climate change. M/s Digri-Gen Ltd.. has proposed 25 MW power project in the close vicinity of DSML. While selecting this site project Proponent have considered following factors on the basis of which the site was finalized. While setting -up the proposed project following parameters were kept in consideration

Site Alternative

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

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

Techno-Economic Considerations

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

- Availability of suitable land for proposed project

- Availability of facility for receipt of raw materials such as bagasse etc
- Availability of adequate water for process within reasonable distance
- Suitability of land from topography and geological aspects
- No displacement of people.
- Availability of construction water and power

Available Infrastructure

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

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

5.2 ENVIRONMENTAL CONSIDERATION

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

a. Avoiding the use of forest land
b. Minimum use of cultivable land
c. Away from thickly populated town
d. Minimum requirement of cutting of trees
e. No displacement of people
f. Away from critically polluted area
g. Away from national park and wildlife sanctuaries
h. Away from tiger reserve/Elephant reserve/turtle nestling grounds.
i. Away from core zone of biosphere reserve.
j. Away from Archeological sites.
k. Away from defense installations.

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

Analysis of Co-Generation

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

5.3 ANALYSIS OF ALTERNATIVE

Technology

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

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

At the same time, the capital and operating costs also impact the selection of steam pressure and temperature parameters.

5.4 ANALYSIS OF BOILER TECHNOLOGY

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

For bagasse firing, traveling grate or dumping grate boilers are utilized. In traveling grate the ash discharge is by grate movement and automatic. In dumping grate the ash has to be removed manually with opening of furnace bottom doors which is not recommended in high pressure boilers. Hence the selection of traveling grates

Analysis of Fuel

Fossil energy resources consist primarily of natural gas and furnace oil. Domestic oil supply is considered negligible and natural gas resources are becoming scarce in India. Moreover, domestic coal is very high in sulfur and ash content, which will lead to severe environmental hazards. The project's proposal for using bagasse, is the best option for environmental and economic reasons. In the absence of any cheaper fuel, bagasse utilization is of prime importance

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

6.1 INTRODUCTION

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

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

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

The Jamrao canal is the principal surface water resource in the project area. The Jamrao canal west brasnch is located about 10..5 Km on north side of the project site which is major source of irrigation. Canal water is the major source of drinking water & irrigation in the area.

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

6.2 AIR EMISSIONS

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

Assessment of potential impacts

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

Mitigation measures

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

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

Environmental aspects	Potential Impact	Description	Consequence severity rating	Likelihood / Frequency	Nature of impact	Geographical location of Impact	Duration of Impact	Reversibility of Impact	Significance of Impact
Protected Areas	Habitat loss, temporary relocation	No protected areas, wetlands or wildlife sanctuary were found inside or in the close proximity of the area.	Low	Low	No impact	Not applicable	Not applicable	Not applicable	Low
Geology and Soils	Soil erosion, soil contamination by the spillage of fuel, oil and chemicals	The construction activity will involve a little bit clearing of land for the purpose of installation of power plant	Medium	Medium	Direct	Local /Regional	Short Term	Reversible	Medium

		units. The land is already acquired by proponent and in use as yard. During construction and fabrication activity, there is the potential for spills of fuel, lubricating oils and chemicals that could lead to soil contamination.							
Water Resources	Depletion of aquifer from overuse, and contamination of water resources by the spillage of fuel, oil and chemicals	The fresh water is available at 5-8 m depth, so proposed project activities will not impact on	Medium	Low	Direct	Local /Regional	Short Term	Reversible (depending on the rainfall pattern and aquifer recharge).	Low

		local water resources. Surface and aquifer quality may deteriorate if pollutants are mixed with Surface runoff during rain and carried to water resources in the vicinity, or if pollutants leach into the ground.							
Air Quality	Vehicular emission, Dust emission	Construction and fabrication of plant activities can generate locally exhaust emission and dust during	Medium	Low	Direct	Local/ Regional	Short Term	Irreversible	Low

		activities such as 'earthmoving' operations by using tower cranes, bulldozer- and other pollutants emission from diesel generators and vehicles.							
	GHG Emissions	The main source for GHG emissions will be generators and vehicles.	Low	Low	Indirect	National	Long term	Irreversible	Low
	Ozone Depletion	HCFC and CFC's if any of them used during project activities, can	Low	Low	Indirect	National	Long term	Irreversible	Low

		deplete ozone layer							
Noise	Impacts at nearest community, Disturbance to the wildlife	There is a potential of disturbance to nearby community due to noise. There is also potential of wildlife temporary relocation because of noise.	Medium	Low	Indirect	Local	Short term	Reversibility	Low
Waste	**Liquid Waste:** risk of liquid waste contaminating aquifer, contaminating surface water	The proposed project activity would generate liquid waste from campsite.	Medium	Low	Direct	local	Short term	Reversible	Low
	Solid Waste (Non-hazardous) Aesthetic issues	The proposed project works will result in	Low	Low	Direct	Regional	Short term	Reversible	Low

		the generation of a range of non-hazardous solid wastes.							
	Hazardous waste: soil, surface and aquifer contamination	Hazardous waste such as waste oil, batteries, Chemicals and clinical waste generated during construction and fabrication activities.	Medium	Medium	Direct	Local	Short term	Reversible	Medium
Traffic	Disturbance to local community	During the project activities, the traffic movement on the main road	Medium	Low	Direct	Local	Short term	Reversible	Low

		and project site will increase. The project site is located near Umerkot road with very low traffic movement, so no major issue will be raised due to movement of vehicles.							

Permissible limits of NOx will be ensured by boiler design (to limit NOx generation). Monitoring of ambient air parameters (PM_{10}, SO_2, and NOx) emissions should be carried out to ensure compliance with the SEQS as per requirement of SMART.

Residual impact

If the mitigation measures are effectively implemented, the residual impact of the proposed activities on the area's air quality is expected to be low in significance.

6.3 WATER RESOURCES POTENTIAL IMPACTS

Proposed activities could affect the area's water resources in two ways by overuse and contamination. Assessment of potential impacts: Water will be required during operational activities. Water will be exploited from groundwater aquifer through deep bore wells. Water conservation practices will be utilized to reduce the water consumption. The domestic effluents shall be collected and treated through on site wastewater treatment system including septic tanks. Process effluents will be collected and treated in a separate network to comply with SEQS. The project area may expect heavy rain and to protect the area from this impact, campsite location will be selected on relatively high ground. All spills will be handled as soon as reasonably practical.

Mitigation measures: Follow good housekeeping practices with all machinery that may potentially discharge wastewater. No untreated effluents will be released to the environment.

Residual impact

The nature of impact is direct and its reversibility depends on the rainfall pattern, catchment size and associated aquifer recharge to the project area. The significance level given is low, because the water in the area is abundant due to the project area's proximity to the Indus River. Proper implementation of the required mitigation and monitoring techniques will prevent any adverse water quality impacts.

6.4 GHG EMISSIONS

Potential Impacts

Greenhouse gases are released as a result of combustion process. The increase in greenhouse gas emissions in the atmosphere due to human activities such as combustion and land use change contributes to the global warming.

Assessment of potential impacts

The Kyoto Protocol is an amendment to the United Nations Framework Convention on Climate Change (UNFCCC) an international treaty on global warming. The proposed project has a high thermal efficiency relative to alternative systems and will produce lower CO_2 emissions per kilowatt of electric generation produced. Greenhouse gas mitigation options include sequestration of CO_2 in biologic 'sinks' such as plant biomass. Proponent committed to plant 20,000 trees along roads, boundary walls and in orchards.

Mitigation measures

There are no generally accepted methods for the mitigation of CO_2 emissions. However, one possible mitigation strategies will be given consideration. This includes carbon sequestration by planting trees. As the plant site is in the area with an average rainfall of 212 mm on the basis of last 10years data, carbon sequestration by planting indigenous trees near the plant site could be viable remedial measure.

Residual impacts

CO_2 emissions contributes to the global warming however, CO_2 emissions from the proposed project will be considerably less per unit electricity generated compared to any other conventional alternative.

Hazardous materials potential issues: The operations of power plant will require use of process chemicals for water treatment, lubrications and corrosion control etc. Some of these chemicals may be of hazardous nature. These chemicals may have a potential to harm human health and contaminate soil, surface and groundwater if not handled correctly.

Assessment of potential impacts

A significant impact will be interpreted if the hazardous materials are not handled properly. The chemicals for the plant operations will include various salts, coagulants, flocculants, sulfuric acid and caustic soda for water treatment and regeneration systems, lubricants etc. for use in plant maintenance and workshop.

Mitigation measures

A chemical and hazardous material handling procedure will be prepared that will contain storage and handling of hazardous materials will be in accordance with international standards and appropriate to their hazard characteristics, storage areas for fuels and liquid chemicals will be designed with secondary containment to prevent spills and contamination

of soil and groundwater. Labeling will be placed on all storage vessels/containers as appropriate to national and international standards. The labeling will clearly identify the stored materials. Supporting information such as material safety data sheets (MSDS) will be available for all hazardous materials. Hazardous materials such as used oil filters, batteries, chemical containers, grease traps etc. will be hauled away by contractor for recycling.

Residual impacts

Implementation of the proposed mitigation measures is not likely to leave any significant impact. The proposed project will avoid use of ozone depleting compounds such as Halon, Chlorofluorocarbons (CFC), Hydro chlorofluorocarbons (HCFC) or any other source which deplete the ozone layer, so the overall assessment of the impact is significantly low.

6.5 PLANT NOISE POTENTIAL ISSUES

The proposed power plant extension will result in increase in noise. The increased noise may be a source of disturbance to nearby communities and residential areas.

Assessment of potential impacts

Noise sources in the community mostly intermittent in nature including road traffic. It can therefore be concluded that area surrounding the power plant boundary has low noise pollution. Noise levels at the power plant location will be high, however only concerned staff will be working in the area with required PPE, and the exposure will be limited to short durations. The residential area is located about 2 Km away from the proposed project site and there will be no significant impact on community. Plantation along the boundary walls of plant will also act as noise barrier and will prevent the noise pollution.

Mitigation measures

Effective noise suppression design and plan will be made for all noise producing equipment. Plantation will be developed along boundary side of plant site.

Residual Impacts

Implementation of the mitigation measures proposed above will result in negligible / no residual impact due to plant noise on surrounding environment.

6.6 WASTEWATER POTENTIAL ISSUES

The power plant operation will generate wastewater in the form of cooling tower blow down, plant low volume wastes and sanitary wastewater from plant colony. The wastewater may be a potential source of pollution to surface and groundwater resources of the area.

Assessment of potential impacts: A significant impact will be interpreted if discharged to the environment exceed the SEQS limits for effluent discharge or World Bank guidelines for effluent discharge from power plant. Similarly a significant impact will be interpreted if wastewater contaminates the groundwater. The wastewater will be treated by using an appropriate treatment technology before discharging into open environment. Treated effluents will comply with SEQS.

Mitigation measures

Wastewater will be treated before discharging into nearby drain canal. Monitoring of effluents should be carried out as per requirement of SMART to ensure compliance with the SEQS and World Bank guidelines.

Residual impacts

Implementation of the proposed mitigation measures and regular monitoring is not likely to leave any significant impact of the wastewater from the proposed power plant.

6.7 SOLID WASTE MANAGEMENT POTENTIAL ISSUES

The solid waste generated during the operational phase of proposed project may pose health hazard, pollute soil, surface and ground water if not managed properly.

Assessment of potential impacts

A significant impact will be interpreted if the waste management is not carried out properly; which may effect to health of workers, pollution of soil, surface or groundwater. Any person is exposed to potentially hazardous waste generated by the project. Excessive wastes are generated, recyclable waste is not recycled, waste are scattered, handling of wastes results in contamination, and wastes are improperly disposed of causing pollution. All wastes generated from the project will be properly handled, stored and disposed of. The environmental impacts will be tiniest after the implementation of the proposed mitigations.

Mitigation measures

It includes separate waste bins will be placed for different type of wastes - plastic, paper, metal, glass, wood, and cotton. Recyclable material will be separated at source and hauled away by contractor for recycling, Non-hazardous non-recyclable wastes such as construction camp kitchen wastes will be properly dispose off. No hazardous such as organic waste (fruit and vegetable etc.) waste will be dumped at any location outside the plant boundary. All

hazardous waste will be separated from other wastes. Hazardous wastes will be stored in designated areas with restricted access and proper marking. Surplus materials including partially filled chemical and paint containers will be returned to suppliers. Inert wastes will be disposed of onsite as fill material. Training will be provided to personnel for identification, segregation, and management of waste.

Residual Impacts:

Proper implementation of the mitigation measures will ensure that the residual impact from waste is minimum.

ENVIRONMENTAL MANAGEMENT PLAN

7.1 PREFACE

The potential environmental impacts are identified from the planning stage of proposed project through Environmental Impact Assessment process. The Environmental Management Plan (EMP) is a tool that serves as to manage environmental impacts and specifically focuses on implementation of mitigation measures in its true sense against likely environmental impacts.

The primary objectives of the EMP are to facilitate the implementation of the identified mitigation measures. It defines legislative requirements, guidelines and best industry practices that apply to the project and the responsibilities of the project proponent. It also defines a monitoring mechanism and identifies monitoring parameters in order to ensure the complete implementation of all mitigation measures and the effectiveness of mitigation measures. It provides the requirements for environmental monitoring and auditing and mechanism for taking timely action in the face of unanticipated environmental situations. The management and monitoring plan is attached in Table 7.1.

7.2 POTENTIAL IMPACTS AND THEIR MITIGATION MEASURES

No	*Impact*		*Mitigation Measures*	*Responsibility*	*Monitoring*	*Timing*
1.	**Air Emissions**	1.1	Monitoring of gaseous emissions should be carried out regularly to ensure compliance with the NEQS and World Bank emission guidelines.	DGL	Records of operational parameters / periodic monitoring of stack emissions	Operation phase
2.	**Water Resources**	2.1	Follow good housekeeping practices with all machinery that may potentially discharge wastewater;	DGL		
3.	**Waste Water**	4.1	Wastewater will be disposed off after required treatment.	DGL	Provision of wastewater treatment plant at design phase/ Monitor compliance	Operation phase
		4.2	Sanitary wastewater will be treated as per waste management plan	DGL	Monitor compliance /wastewater sampling and testing records	Operation phase

		4.3	Monitoring of effluents should be carried out as per requirement of SMART to ensure compliance with the SEQS and World Bank guidelines.	DGL	Monitor compliance /wastewater samplingand testing records	Operation phase
		4.4	No hazardous untreated effluents will be released to the environment	DGL	Monitor compliance	Operation phase
4.	**Waste Management**	5.1	Separate waste bins will be placed for different type of wastes - plastic, paper, metal, glass, wood, and cotton	DGL	Monitor compliance Operation phase	Operation phase
		5.2	Recyclable material will be separated at source.	DGL	Monitor Compliance	Operation phase
		5.3	Non-hazardous non-recyclable wastes such as construction camp kitchen wastes will be disposed off on designated site.	DGL	Monitor Compliance	Operation phase
		5.4	No waste will be dumped at any location outside the plant boundary.	DGL	Monitor compliance	Operation phase
		5.5	All hazardous waste will be separated from other wastes. Hazardous wastes will be stored in designated areas with restricted access and proper marking.	DGL	Monitor compliance	Operation phase
		5.6	An emergency response plan will be developed for the hazardous waste (and substances).	DGL	Develop and implement emergency response plan.	During constructi on phase
		5.7	All containers of hazardous waste will be appropriately labeled.	DGL	Check compliance	During constructi

						on phase
5.	**Hazardous Material**	6.1	Storage and handling of hazardous materials will be in accordance with international standards and appropriate to their hazard characteristics	DGL	Monitor compliance	Operation phase
		6.2	Storage areas for fuels and liquid chemicals will be designed with secondary containment to prevent spills and contamination of soil and groundwater.	DGL	Monitor compliance	Planning and designpha se/Operat ion phase
		6.3	Labeling will be placed on all storage vessels/containers as appropriate to national and international standards. The labeling will clearly identify the stored materials.	DGL	Monitor compliance	Operation phase
		6.4	A Hazardous Materials Register will be in place to cover hazardous material name, HAZCHEM/United Nations Code, Material Safety Data Sheet (MSDS), summary of maximum inventory, storage requirements and precautions, location, physical properties of the materials and approved disposal methods.	DGL	Monitor compliance /Disposal records	Operation phase
6.	**Occupational Health & Safety**	7.1	**Electrical Hazards**			
		7.1.1	Written procedures to de-energize circuits that will be impacted by the repair activity will be prepared.	DGL	Monitor compliance	Operation phase
		7.2	**Confined Space Entry**			
		7.2.1	Standard procedures for confined space entries will be prepared. The procedure will include: electrical lockout, air testing before and during entry, proper respiratory protection if required, standby help (buddy system), and piping system	DGL	Monitor compliance	Operation phase

			disconnection.			
		7.3	**Machine Guarding**			
		7.3.1	Proper machine guarding, which is critical for the prevention of injuries to workers by isolating them from moving machinery, will be provided.	DGL	Monitor compliance	Planning and design phase
		7.4	**Eye Head and Foot Protection**			
		7.4.1	Head protection will be worn in appropriate plant areas, i.e., power block and production areas. Open-toed shoes will be prohibited. Eye protection will be required during all maintenance activities involving dust exposure or the production of particulates from sanding or grinding activities.	DGL	Monitor compliance	Operation phase
		7.5	**Fire and Explosion Hazards**			
		7.5.1	Firefighting equipment will be available in the form of ABC fire extinguishers as a minimum, and their locations will be clearly marked.	DGL	Monitor compliance	Operation phase
		7.5.2	Exits from work places will be well marked and visible in dim light.	DGL	Monitor compliance	Planning and design phase
		7.5.3	Fire water will be located throughout the plant in well-marked piping.	DGL	Monitor compliance	Planning and design phase
		7.5.4	An emergency response plan will be prepared for evacuation of personnel and equipment.	DGL	Emergency responseplan, record of drills	Operation phase

		7.6	**Housekeeping**			
		7.6.1	Housekeeping will be frequent and thorough to prevent slips, trips, and falls.	DGL	Monitor compliance	Operation phase
		7.6.2	A lockout / tag out program will be implemented.	DGL	Records of lockout/tag out	Operation phase
		7.7	**Chemical Exposure**			
		7.7.1	Proper precautions will be taken to minimize employee risk to chemical exposure	DGL	Records ofoccupational air monitoring.	Operation phase
		7.7.2	Provision will be made for respirator usage in areas where chemical exposure concentrations are exceeding the guideline values.	DGL	Monitor compliance	Operation phase
		7.8	**Noise Level Exposure**			
		7.8.1	Provision will be made for PPEs in areas with noise levels exceeding the guideline values.	DGL	Monitor compliance	Operation phase
		7.8.2	A hearing conservation programme for plant workers will be started which may include: audiometry, training in the use of hearing protection (ear muffs, plugs, canal caps), identification of areas that have high (85 dB (A) or above) sound levels, and discussion of the effects of noise exposure	DGL	Monitor compliance	Operation phase
		7.8	**Noise Level Exposure**			
		7.8.1	Provision will be made for PPEs in areas with noise levels exceeding the guideline values.	DGL	Monitor compliance	Operation phase
		7.8.2	A hearing conservation programme for plant workers will be started which may include: audiometry, training in the use of hearing protection (ear muffs, plugs, canal caps), identification of areas that have high (85 dB (A) or above) sound levels, and discussion of the effects of noise exposure.	DGL	Monitor compliance	Operation phase

		7.9	**Heat Related Stress/Illness**			
		7.9.1	Staff will be trained for management of heat related stress and illness, such as proper work/rest cycle and increased intake of fluids during hot weather.	DGL	Monitor compliance	Operation phase

7.3 BOILER EMISSIONS CONTROL OPTIONS - NO_x

NO_x control has been a focus of emission control research and development in boilers. The following provides a description of the most prominent emission control approaches.

Combustion Process emissions Control

Combustion control techniques are less costly than post-combustion control methods and are often used on industrial boilers for NO_x control. Control of combustion temperature has been the principal focus of combustion process control in boilers. Combustion control requires tradeoffs - high temperatures favor complete burn up of the fuel and low residual hydrocarbons and CO, but promote NO_x formation. Very lean combustion dilutes the combustion process and reduces combustion temperatures and NO_x formation, and allows a higher compression ratio or peak firing pressures resulting in higher efficiency. However, if the mixture is too lean, misfiring and incomplete combustion occurs, increasing CO and VOC emissions.

Flue Gas Recirculation (FGR)

FGR is the most effective technique for reducing NO_x emissions from industrial boilers with inputs below 100 MMBtu/hr. With FGR, a portion of the relatively cool boiler exhaust gases re-enter the combustion process, reducing the flame temperature and associated thermal NO_x formation. It is the most popular and effective NO_x reduction method for fire tube and water tube boilers, and many applications can rely solely on FGR to meet environmental standards.

External FGR employs a fan to re-circulate the flue gases into the flame, with external piping carrying the gases from the stack to the burner. A valve responding to boiler input controls the recirculation rate. Induced FGR relies on the combustion air fan for flue gas recirculation. A portion of the gases travel via duct work or move internally to the air fan where they are premixed with combustion air and introduced into the flame through the burner. Induced FGR in newer designs utilize an integral design that is relatively uncomplicated and reliable. The physical limit to NO_x reduction via FGR is 80 percent in natural gas-fired boilers and 25 percent for standard fuel oils.

Low Excess Air Firing (LAE)

Boilers are fired with excess air to ensure complete combustion. However, excess air levels greater than 45 percent can result in increased NO_x formation, because the excess nitrogen

and oxygen in the combustion air entering the flame combine to form thermal NO_x. Providing less excess air means limiting the amount of excess air that enters the combustion process, thus limiting the amount of extra nitrogen and oxygen entering the flame. This is accomplished through burner design modification and is optimized through the use of oxygen trim controls. LAE typically results in overall NO_x reductions of 5 to 10 percent when firing with natural gas, and is suitable for most boilers.

Burner Modifications

By modifying the design of standard burners to create a larger flame, lower flame temperatures and lower thermal NO_x formation can be achieved, resulting in lower overall NO_x emissions. While most boiler types and sizes can accommodate burner modifications, it is most effective for boilers firing natural gas and distillate fuel oils, with little effectiveness in heavy oil-fired boilers. Also, burner modifications must be complemented with other NO_x reduction methods, such as flue gas recirculation, to comply with the more stringent environmental regulations. Achieving low NO_x levels (30 ppm) through burner modification alone can adversely impact boiler operating parameters such as turndown, capacity, CO levels, and efficiency.

Water/Steam Injection

Injecting water or steam into the flame reduces flame temperature, lowering thermal NO_x formation and overall NO_x emissions. However, under normal operating conditions, water/steam injection can lower boiler efficiency by 3 to 10 percent. Also, there is a practical limit to the amount that can be injected without causing condensation-related problems. This method is often employed in conjunction with other NO_x control techniques such as burner modifications or flue gas recirculation. When used with natural gas-fired boilers, water/steam injection can result in NO_x reduction of up to 80 percent, with lower reductions achievable in oil-fired boilers.

7.4 POST-COMBUSTION EMISSIONS CONTROL

There are several types of exhaust gas treatment processes that are applicable to industrial boilers.

Selective Non-Catalytic Reduction (SNCR)

In a boiler with SNCR, a NO_x reducing agent such as ammonia or urea is injected into the boiler exhaust gases at a temperature in the 1,400 to 1,600° F range. The agent breaks down the NO_x in the exhaust gases into water and atmospheric nitrogen (N_2). While SNCR can

reduce boiler NO_x emissions by up to 70 percent, it is very difficult to apply this technology to industrial boilers that modulate or cycle frequently because the agent must be introduced at a specific flue gas temperature in order to perform properly. Also, the location of the exhaust gases at the necessary temperature is constantly changing in a cycling boiler.

Selective Catalytic Reduction (SCR)

This technology involves the injection of the reducing agent into the boiler exhaust gas in the presence of a catalyst. The catalyst allows the reducing agent to operate at lower exhaust temperatures than SNCR, in the 500 to 1,200° F depending on the type of catalyst. NO_x reductions of up to 90 percent are achievable with SCR. The two agents used commercially are ammonia (NH_3in anhydrous liquid form or aqueous solution) and aqueous urea. Urea decomposes in the hot exhaust gas and SCR reactor, releasing ammonia. Approximately 0.9 to 1.0 moles of ammonia is required per mole of NO_x at the SCR reactor inlet in order to achieve an 80 to 90 percent NO_x reduction.

SCR is however costly to use and can only occasionally be justified on boilers with inputs of less than 100 MMBtu/hr. SCR requires on-site storage of ammonia, a hazardous chemical. In addition, ammonia can "slip" through the process unreacted, contributing to environmental and health concerns.

7.5 BOILER EMISSIONS CONTROL OPTIONS - SO_X

The traditional method for controlling SO_x emissions is dispersion via a tall stack to limit ground level emissions. The more stringent SO_x emissions requirements in force today demand the use of reduction methods as well. These include use of low sulfur fuel, desulfurizing fuel, and flue gas desulfurization (FGD). Desulfurization of fuel, such as in FGD, primarily applies to coal, and is principally used for utility boiler emissions control. Use of low sulfur fuels is the most cost effective SO_x control method for industrial boilers, as it does not require installation and maintenance of special equipment.

7.6 KINDS OF IMPACT EXERCISED

Potential project impacts which are provided for the consideration within the investigation of scale identification and the composition of impacts on the environment include the next aspects:

Air quality: The investigation on modeling the dispersion pollutants in the atmospheric air was carried out with the purpose of the assessment of the supposed emission levels.

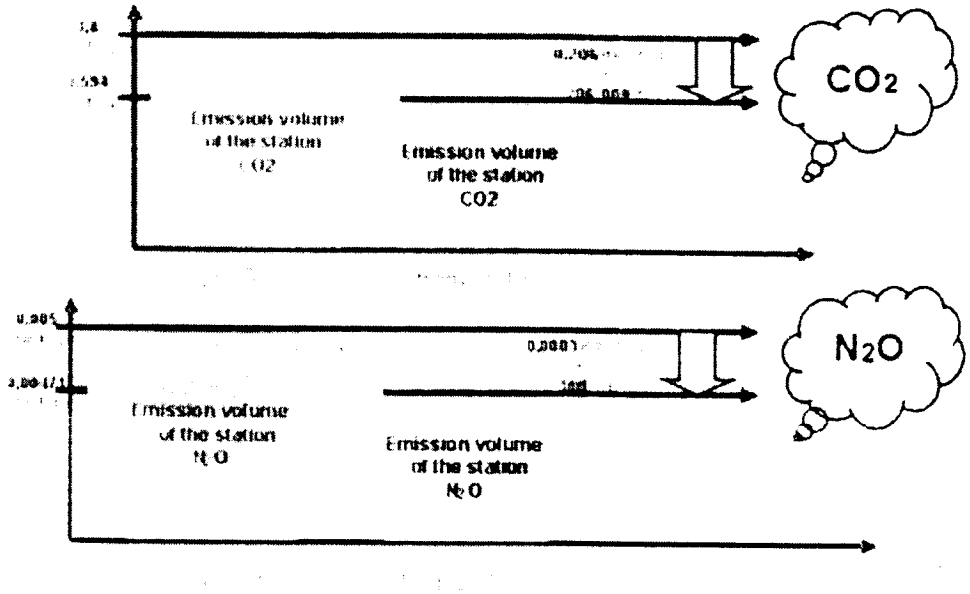


Fig 7.1: Greenhouse gas emission reduction

The basic question, which would be considered within the framework of this investigation, will be an identification of the levels of possible pollutant impacts on the atmospheric air condition at the boundary of the estimated sanitary protection zone of the enterprise.

Waste: The organization scheme assessment of waste management with the purpose of providing the maximum reduction of the impact level connecting with generation and disposal of wastes.

Energy resources and greenhouse gas emissions: The questions connecting with energy resources consumption and generation of greenhouse gas emissions.

Acoustic regime: The noise impact assessment connecting with the object operation, in the context of the existing regulatory requirements.

Social factors: The questions of population employment, labor conditions and the proposed object impacts connecting with it.

Soil cover: The investigation of the project impacts on the soil condition determines the possibility for mechanical breaking of the soil condition in the course of the construction, as well as for the threat of polluting by the object operation.

Vegetable cover: General characteristic of the vegetation, typical to this area (the realization of the project will not lead to the change of vegetable cover of this area, as there is no vegetation on the site).

Fauna: The characteristic of the fauna in this area and the assessment of the object impact on the wildlife habitual area.

Surface-water: The assessment of the projected object impacts on the surface-water objects by taking out them for the production needs.

Geological environment and groundwater: The investigation of the projected activity efficiency intended for the prevention of leakages and occurrence of erosion, karstic and other things on the pipeline routes.

7.7 IMPACT AT THE CONSTRUCTION STAGE

The main impact at the stage of construction will be bound to dusting in the course of the construction work. However, with taking into consideration the fact that the nearest dwelling houses are situated at the distance of 680 m, the main type of risk is the dust emission impact on the health of the manufacturing personnel, working at the site. In order to decrease this impacts the activities on dust emission control and its exclusion will be implemented together with the measures that guarantee the permanent usage of the respective personal protective equipment.

As a result of the estimation of transport emissions it was established that the degree of automobile exhaust gas impacts is insignificant.

- Pollutants emissions into the atmosphere in the course of the construction will not influence on the health of the residents living near project area and, as a result of providing the protective measures, on the health of the personnel.

Groundwater pollution at the construction site may turn out to take place under the migration of the existing polluting compounds presenting in the earth or/and as a result of the entrance of the materials used in the course of the construction work.

The reduction of the risk degree will provided by means of cleaning the extremely polluted grounds in the proportion to their identification with the subsequent disposal of the extracted polluted earth at the specially equipped areas for dangerous waste disposal

outside the enterprise territory. In order to reduce the risk of polluting as a result of spillage and leakage the storage of potentially dangerous materials will be provided in the special containers.

The stipulated control system of dangerous substances storage and the liquidation of pollutants entrance into the soil will make it possible to avoid polluting groundwater by the construction.

The extraction of the old construction elements: underground communication, basement parts, polluted and techno-genic soil will lead to the earth de-compaction and the loss of groundwater protection. The minimization of these negative impacts is possible at the expense of the construction term acceleration and the observation of the recommendations from the EIA section, excluding the entrance of pollutants into the open trenches and pits.

The over site excavation is evidently projected as the minimum one. Significant impacts on the geological environment ought not to be expected within such conditions.

Driving pits under the buildings and engineering constructions determines the most significant impacts on the geological environment. The depth and the size of these pits are designed in such a way that almost the whole thickness of the aeration zone rocks will be blocked by the underground part of the constructions. Therewith a rather weak de-compaction of the rocks of the future basement and a possible lowering of the groundwater level by dewatering are predicted.

The construction of the proposed power plant is planned to be carried out within the earliest possible time with the application of the developed nature-oriented technologies that will make it possible to minimize the impact on the geological environment.

7.8 IMPACT AT THE OPERATION STAGE

Impact on the atmospheric air

Nowadays pollutant concentration in the atmospheric air of the enterprise location area is big enough. Besides, under the results of the long-term monitoring of the atmospheric air it was determined that the concentration of dust, nitrogen dioxide and carbonic oxide has increased three times for 18 years.

- There is a stable tendency of the significant deterioration of the atmospheric air quality over the years. Rejecting the facility replacement with a new, more

producible and environmentally friendly one will preserve this tendency and worsen the environmental situation in the region.

The estimation of the pollutant concentration in the atmosphere are made under the three scenarios:

- Existing condition
- Maximum development (the projected power-generating unit sources are added to the existing emission sources)

It is necessary to mention, that the estimation is made for the situation when all units work with peak load, that extremely rare happen in practice. At the next stages of projecting operation conditions of facilities will be specified and the probability of such a situation will be estimated. The projected combined cycle gas turbine power plant is characterized by a significantly lower emission rates.

Acoustic regime impact

As it generally known, there is an acoustic discomfort zone for any fuel combusting enterprise. The estimation made shows, that the acoustic discomfort zone for the enterprise does not exceed 180 m that is much lower sanitary protection zone of the facility.

In order to reduce the noise level made at the projected plant it is planned to introduce a number of activity, among which are:

- Sound levels, created by the proposed facility, must not exceed 75dBA within one meter of coating.
- The sound-deadening system of GTP air intake duct must provide the reduction of the sound level up to до75dBA at the distance of 1m from the surface of air intake.
- The installation of sound attenuators into ventilating systems, serving the rooms with the permanent people stay.
- The application of sound protecting enclosure inside the room.
- The installation of ventilators with vibration isolators.
- Connecting ventilator sets with air duct through flexible connectors etc.

7.9 LANDSCAPE AND VISUAL CHANGES

The site for the proposed plant is leased from Digri Sugar Mills from their premises and there were warehouses earlier at the side singled out for the construction. Therefore, the

planning activity is not connected to the deforestation of woody shrubby vegetation, the elimination of greenery and will not lead to the reduction of green plantation size within the region of the object location, and will even allow increasing the green plantation size within the green space work.

7.10 MATERIAL UTILIZATION AND WASTE MANAGEMENT

The waste products generated in the course of the operation will be same as that of other bagasse based cogeneration power plants.

However, the frequency of transformer fluid, accumulator battery change will be reduced with putting the proposed facility into the operation, as the performance life of the plant transformers is 30 years without oil change, and the performance life of accumulator batteries is 25 years.

The opportunities for minimization the quantity of waste generation will be searched out in the course of organizing the management system of waste that are generated during the operation:

- Sorting out is made according to the classes of danger with the subsequent division of waste products which depends on the type (this division makes the waste management procedure easier as well as the process of recycling more economical).
- All actions on the collection and storage of waste shall be done according to the Project of Standards on Waste Generating and Disposal Limits
- Location, projecting and operating of objects are to be organized in such a way that provides work condition security as well as minimization of potentially unfavorable impact of stored waste on the environment, constructions and public health.
- Sorting out waste products is to be made according to their class of danger, their physical and chemical properties when collecting and storing them.
- Operations of waste collection and storage are to be provided with containers of appropriate size and for the waste which has a relevant danger class, adequate physical and chemical properties.
- Marking of containers, used for waste collection and storage, as well as registration in respective documents of such data as a source of waste products, their quantity, a danger class, a collection date and a date of disposal at the production facility with the purpose of storage are to be made.

- Sorting out and storage of waste products are subjects to take into account the way of their final application (i.e., the waste for recycling is provided to be stored separately from the waste for neutralization and disposal).
- Collection of household rubbish in plastic packages, washing and disinfecting the containers which were subject to rupture or damage are to be provided etc.

Impact on the surface-waters

Water withdrawal for the plant will be made from the tube well and the nala canal as an alternate (if required). The volume of the surface-water withdrawn remains at the same level. Separate collection of sewage allows guaranteeing a high quality of sewage treatment. Foul drainage from the sanitary sewage system will be made into the available sewage system of the facility, and further into the municipal sewage system.

Rainy and industry storm drains are to be exported by a net of gulley into the storm sewage system. An opportunity is provided for making laboratory tests that check the quality of water to ascertain whether it is necessary to establish a water treatment systems before the water drainage into the common sewage system. Than the water is exported into the local municipal disposal system.

Drains dirty with mazut and oil are exported into the oil and mazut drain tanks for the subsequent treatment. The treated sewage are directed into the cycle of water processing, oil-slime is drained into the oil-slime storage unit.

Impact on the ground waters

A significant impact on the ground waters is not expected in the course of operation. Effective measures against leakage out of reservoirs and the underground water-bearing communications must be developed within the project.

The leakage and soakage of polluting substances from the adjacent areas are probable negative factors worsening the quality of the groundwater. Organized permanent monitoring of the groundwater allows identifying and eliminating the probable entrance of the polluting substances.

Impact on the soils

The most significant impacts on the site soils are mechanical movements, warehousing into piles and clamp as well as soil replacement. These impacts may be positive by the renewal of

earlier polluted soil cover. The impact may occur in the course of operation when oil products may leak. For this case an activity complex is provided for the protection from leakage which includes:

- application of special anticorrosive coats;
- technical examination, diagnosis and testing;
- computation of wall thickness on the basis of providing strength and safe operation by the working temperature range;
- Periodic examination and control etc.

Dangerous waste storage on the open soil is precluded as it may cause the entrance of polluting substances into the soils.

7.11 IMPACT ON THE GEOLOGICAL ENVIRONMENT

Construction yielding by building and construction operation is expected to be minimum and short-term. Vibration attending the machinery work will not have a negative impact on the foundation soil. These soils do not have such a negative feature as thixotropy and will not reduce their bearing value. Watering the green plants by landscaping is projected within the consumption that is not enough to provoke under flooding the area.

Impact on the social and economic conditions

The main impact of the construction and operation of the project on the economy of the town and the Territory on the whole will be connected to the disposition of the contracts for building and for procurement of construction materials. It is also planned to conclude contracts with local companies for execution of work on transportation and disposal of solid domestic waste, delivery of necessary materials and facilities.

The impact of the construction and operation of the project on the social economic conditions of the project area will be positive, and, first of all, infers creating additional job positions, increasing the income of workers and purchasing activity of the population due to material purchases and service providing for the construction needs.

The important impact of the project realization must become the growth of the work position amounts as in the town so as in the region. Industrial sectors where power industry plays the essential role intensively develop in the Territory and adjacent regions in recent years. In connection with this project realization there will also appear an opportunity that

encourages the growth of electric and thermal power supply for domestic needs of the developing town, for social and commercial economy sectors of the town, the Territory and the whole region, the growth of salaries, the migratory population increase and the improvement of other social rates. Owing to the project realization all mentioned above rates either stabilize the social situation in the Territory, or make it better.

In the course of the project realization the industrial capacities will be provided by thermal or electric power from the captive production that will not negatively affect the electric power generation, energy supply of the town.

The construction and operation of power plant will not make any pressure on the existing health service in the town, as the town has the necessary capacities to render such kind of services. As new land allotment for the new object construction is not required, this will not influence on agriculture, resort territories. In whole a positive impact of this project is expected on the social economic situation in the project area.

7.12 SUMMARY OF IMPACTS

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

	noise. It may include: • Switch off plants and facilities when they do not work. • Determine the site working hours. • Develop a work program to minimize the work during the non-working hours (not daytime). • A brief instruction of all workers about the noise control measures. • Use temporary screens or partial enclosure of the territory, where the activity takes place.	impact.	negative impacts
Impact on the atmospheric air	• Development of normative standards of maximum permissible emissions for the sources of all pollutants, providing the correspondence of near the ground concentrations at the bounds of sanitary protective zone to the maximum permissible concentrations. Development of activity on the emission regulation during the period of unfavorable meteorological conditions. • Organization of permanent control after pollutant emissions into the atmosphere with the application of the results of planned observations.	• After putting the plant into the operation the concentration of most pollutants in the atmospheric air remain the same or decrease. • The emission of greenhouse gases decrease.	positive impact
Possibility of emergency	• Surface air monitoring at the bound	• Operation of the proposed plant	Insignificant positive

developing	of the sanitary protective zone and the zone of facility influence. • Possibility of emergency developing Investigation of the whole range of possible measures and means, which may be opposed to the dangerous factors with the purpose of their parrying within the advantages of the environmental safety. • Quantitative analysis of the possibilities for one or another situation to appear, of effectiveness of different measures and means of their parrying. • Creating the system of a complex monitoring and management of environmental safety. • Taking a complex of decisions, that excludes depressurization of facilities and preventing emergency emissions of dangerous substances as well as reducing corrosive attacks of pipelines and shut-off-and-regulating fixtures. • Proving disclosure means to control emergencies. • Development of fire prevention activities.	may increase danger. However, the creation of environmental safety management system, representing the aggregate of juridical, organizational and economic mechanisms, intended to decrease the environmental risk to the acceptable level, and in case of emergency with an impact on the environment to provide security to people and to the environment, will help to achieve the maximum reduction of possible damage and compensation of the caused loss.	impacts

	• Having a plan of work on liquidation emergency spill of fuel, lubricants and mazut. • Development of procedures on preventing emergencies (including fire, spills, etc.) • Provide the respective training for personnel and give out the necessary equipment.		
Impact on surface-waters	• Application of separate system of sewage disposal • Application of modern systems of water treatment, grounded on the analysis of sewage quality. • Monitoring the condition of water from the surface sources. • Quality control of entering and exporting of sewage. • Liquidation plan correction of oil product overflows and its approval.	• The impact on surface-water is minimized	Insignificant positive impacts
Impact on soils	• Mechanical removal, storage into piles and clamps as well as soil replacement with a qualitative one. • Organization of specialized places to exclude the soil contact with the substances of higher danger. • Development of the complex of activities which exclude the	• Soil quality improvement at the expense of the replacement of degraded soil with a qualitatively new one. • The possibility of potential soil pollution being a result of oil spill is insignificant due to the application of preventive	Insignificant positive impacts

	possibility for oil products to leak on the soil surface.	measures complex.	
Waste generation	• Permanent monitoring of the waste disposal places. • Approval (renewal) licenses and permissions on waste treatment. • Having approved instructions on collecting, storing and transporting the production waste. • Making records of all data about the delivered and recycled waste and providing the respective reports. • Waste sorting out and storage with account of the direction of its finale usage. • Marking of containers, used for waste collection and storage, as well as registration in respective documents of such data as a source of waste products, their quantity, a danger class, a collection date and a date of disposal at the production facility with the purpose of storage. • Maximum possible replacement of toxic materials with less dangerous. • Sorting out according to the classes of danger with the subsequent waste separation depending on the type.	• Insignificant change of qualitative and qualitative composition of waste • Waste impact on the environment is assessed as in significant under the condition of realizing the developed projected decisions concerning the rules of temporary storage and established frequency of their removal to recycling and disposal.	Minimum positive impact

	• Activities on reducing the amount of generated waste.		
Impact on groundwaters	• Development of measures against leakage from reservoirs and from the underground water-bearing communications. • Development of the system of hydrogeological monitoring.	• The possibility of the impact on the groundwaters is small.	Minimum positive impact
Impact on flora and Fauna	• Accomplishment of the works on landscaping.	• Landscaping work will allow to extend the area of greenery.	Minimum positive impact
Impact on the geological environment	• Speeding up the construction terms and observing the recommendations of the IEE (EMP) section, which exclude pollutants entering into the open trenches and pits. • Monitoring of the impact on the geological environment.	• The subsidence of buildings in the course of use of buildings and constructions is expected to be minimum and short-term. • The impact of vibrations and impoundment of areas is extremely insignificant.	Extremely insignificant negative Impact
Social impacts		• Creating additional jobs. • Increase of employee incomes and population purchasing activity due to procurement of materials and supply of services for construction necessities.	Positive impact

CONCLUSION & RECOMMENDATIONS

8.1 GENERAL

An Initial Environmental Examination report has been prepared for cogeneration power plant based on existing baseline environmental quality data, Identification and prediction of significant environmental impacts due to the proposed activity followed by delineation of appropriate impact mitigation measures and suggestion for implementing this measure by preparing an Environmental Management Plan (EMP).

8.2 PROLOGUE

- The land is acquired from the existing area of Digri Sugar Mills. Proposed project will be in existing available area; therefore issues related to land acquisition, displacement of people etc do not arise.
- Use of latest technology and modernization will lead to energy saving, cost effective and efficient process.
- Cogeneration plant using biomass will solve problem of bagasse disposal.
- Recycle and reuse of bagasse in boiler have added advantage of pollution control as ash and sulfur content is very low.
- Water requirements of the plant will be met form the existing tube well facility
- Energy produce from cogeneration plant will be supplied to national grid

During the environmental examination study, all possible environmental aspects have been adequately addressed and necessary control measures have been suggested to meet with statutory requirements. The proposed project will contribute to economic growth in indirect way and may help in meeting the increasing demands of power if proved to be economically beneficial for future production.

Environmental setting Base line data for environmental aspects like air, water, soil, land use land cover was collected from the plant location. Ecological conditions were studied in within 10km radius there is no reserve forest, natural park or wildlife sanctuary in this area.

The area is flat and no recorded sites of archaeological importance exist. Socio economic study was carried out through primary survey and secondary information from census report. Meteorological data was obtained and Wind rose was drawn and according to wind condition.

Ambient air quality was measured from the project area. All parameter values were within SEQS limits. Similarly noise measured from project location in the study area was within prescribed regulation.

Environmental Assessment

Environmental Assessment has been carried out component wise. Mitigation measures are described in detail for each environmental aspect. The proposed Project brings in multifold advantages. Not only does it produce clean, pollution free energy, by adopting environmental friendly and latest technology. Design criteria for power plant are arrived at with best available alternative. Project also has the capacity to provide employment to the people living in and around that area.

Environmental & Management Monitoring Program

Environment monitoring program has been delineated to confirm all the compliances as per the statutory requirement and minimize environmental risk and to identify unexpected changes in the operation of the plant. The post project monitoring program is suggested to keep all the environmental parameters under control throughout the operation of various processes. Cost for environmental monitoring plan has also been computed.

8.3 CONCLUDING REMARKS

Occupational, safety, health and environmental protection policy has been given to have safe operations in the plant. Green belt development, provision of rain water harvesting structure, corporate social responsibility and occupational health surveillance program has been emphasized to have better environmental statues in and around the plant premises. Environmental Management Plan has been described to facilitate effective management to control mitigation measures during operation storage handling and transportation of materials and products. Manpower requirement has been identified to control all environmental and legislative issues related to the industry.